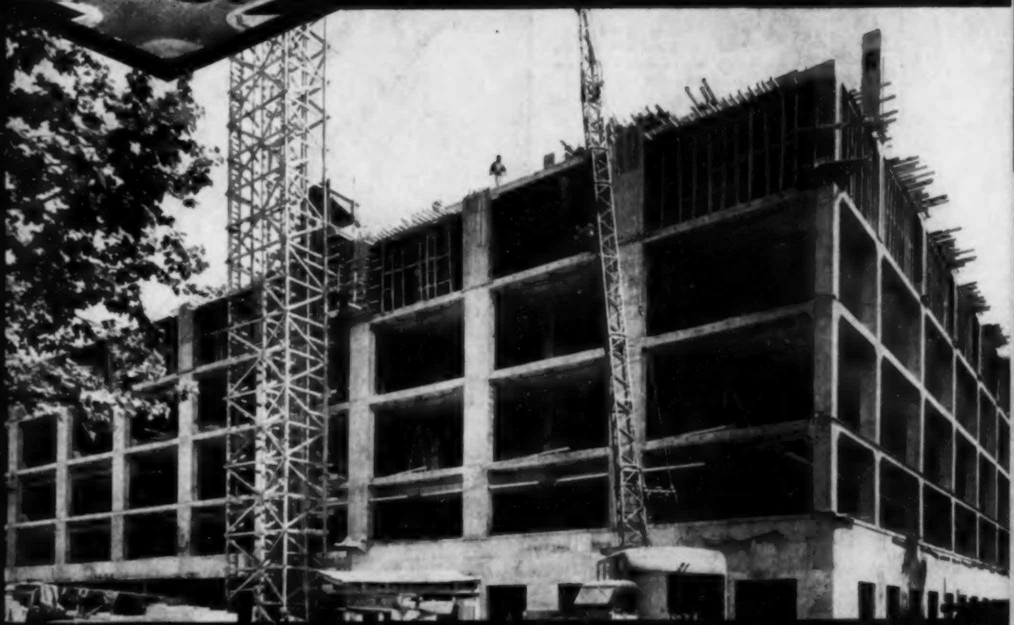
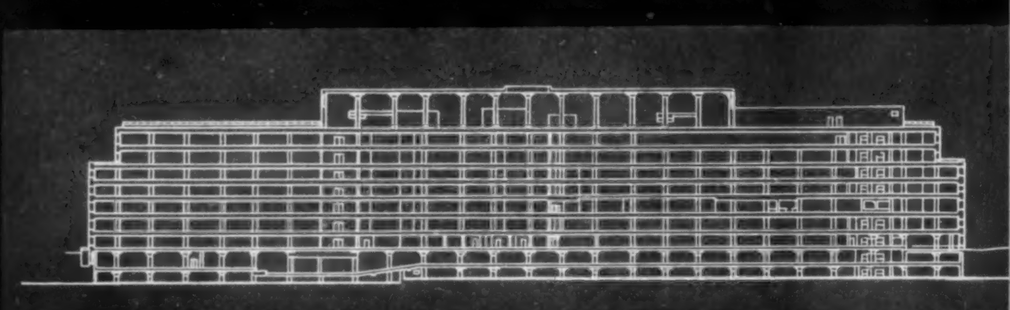
CIVIL ENGINEERING



1852
ENNIAL of ENGINEERING
1952

ERAL ACCOUNTING
OFFICE BUILDING
WASHINGTON, D. C.

See article by W. E. Reynolds



AMERICAN SOCIETY OF CIVIL ENGINEERS
FOUNDED 1852

The Western notes now leave the ... colleagues have introduced of Mr. Halley's package, too. ... against the curtain of darkness.

PAUL M. KAUFMAN,
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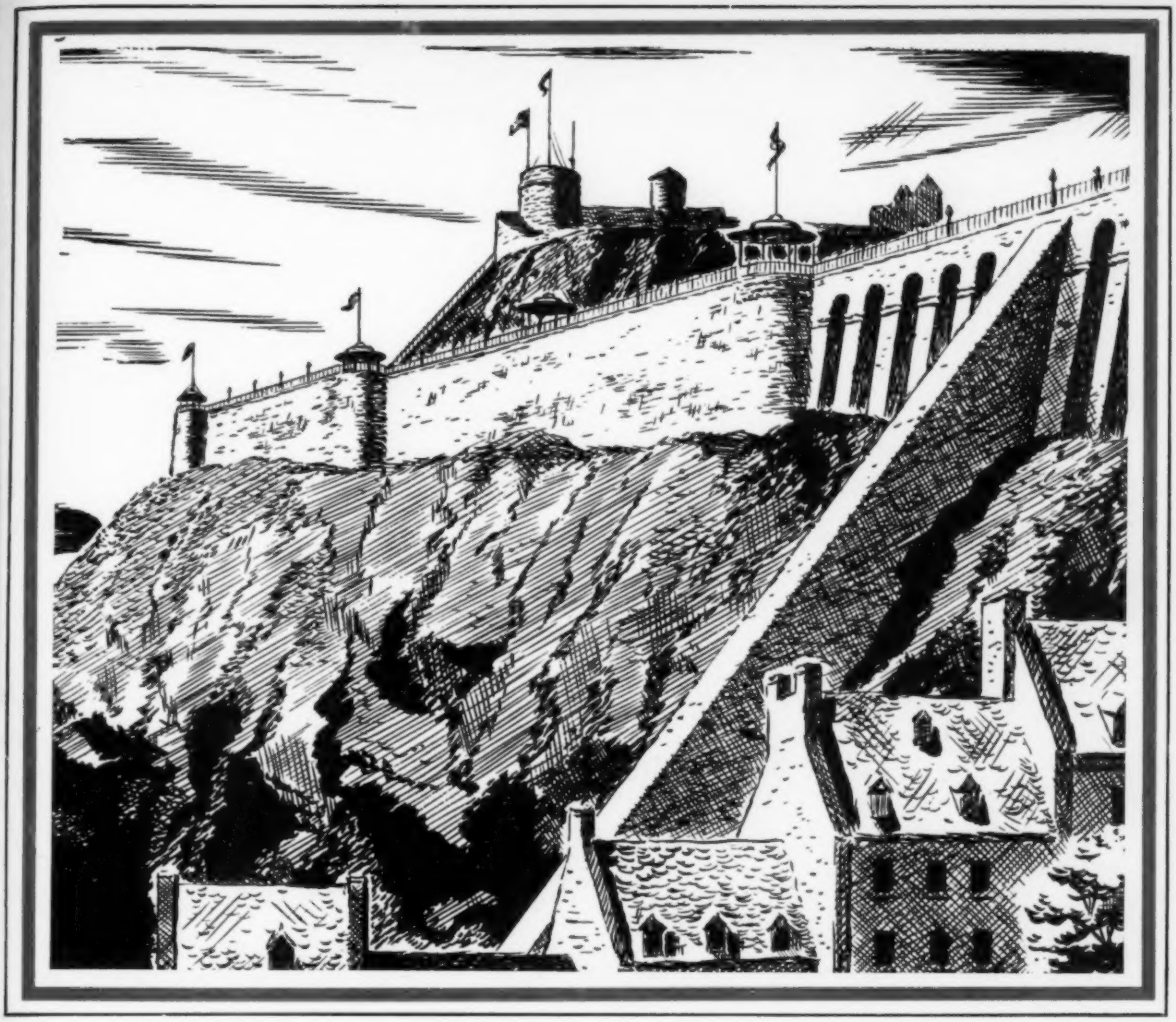

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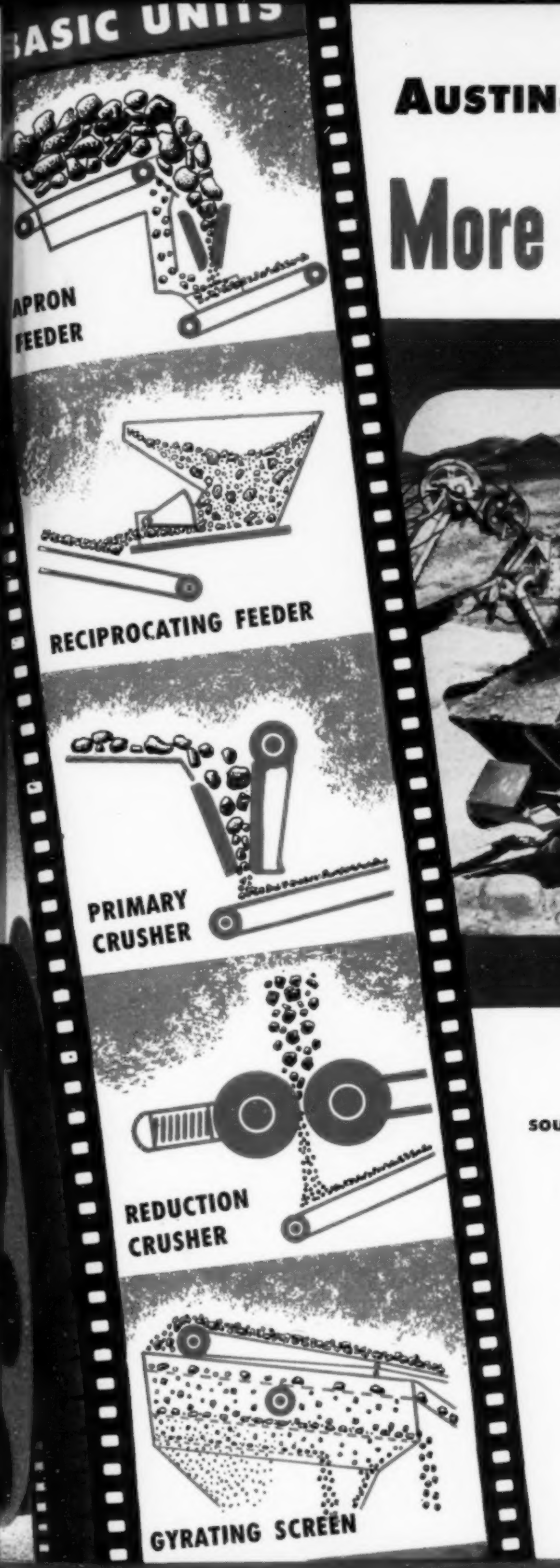
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TD-24s rip up 35,000 yards of rock that otherwise would have needed blasting

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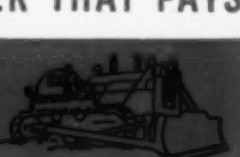

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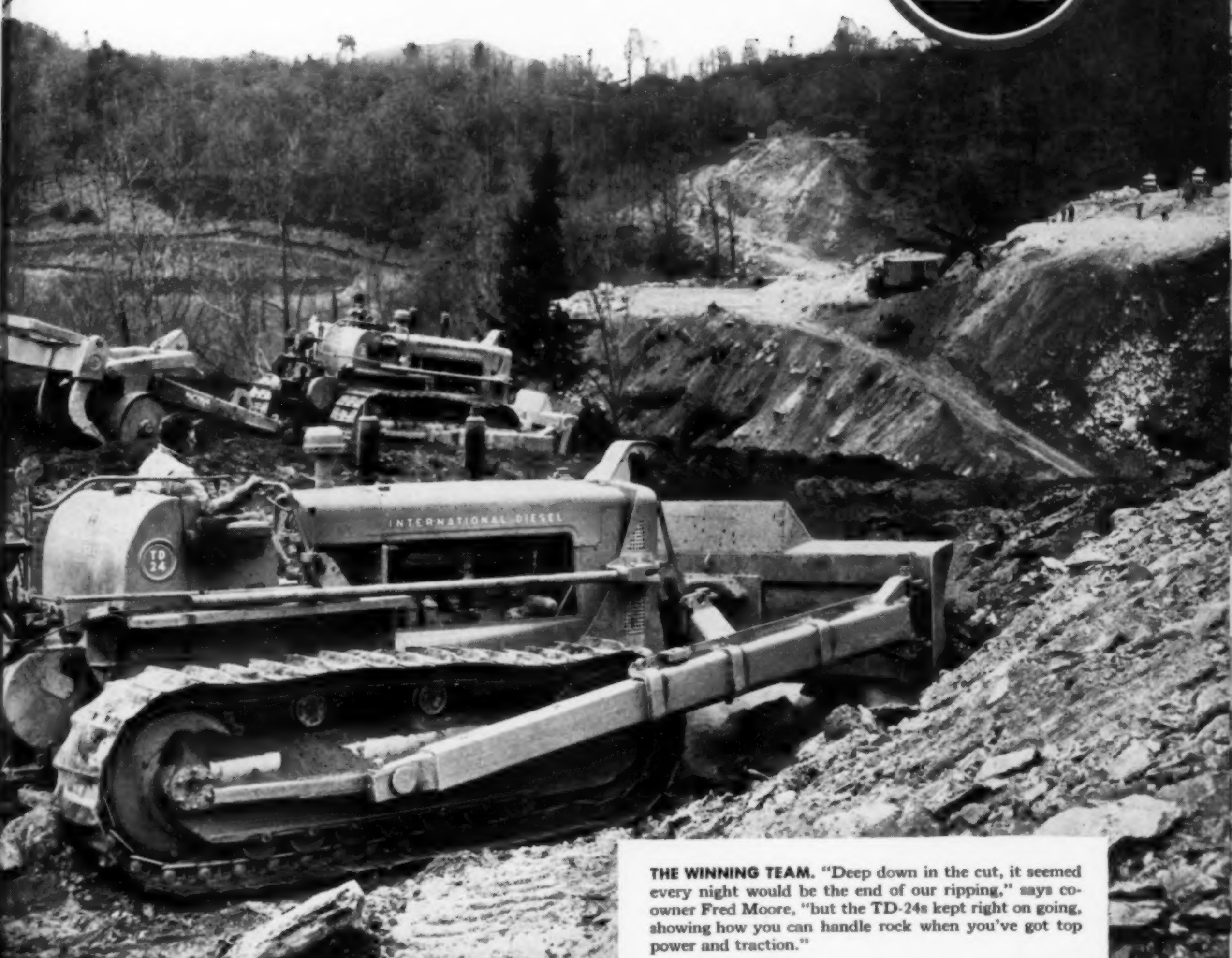

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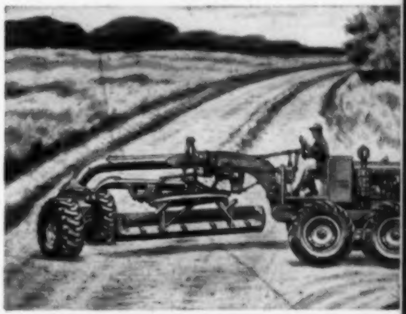

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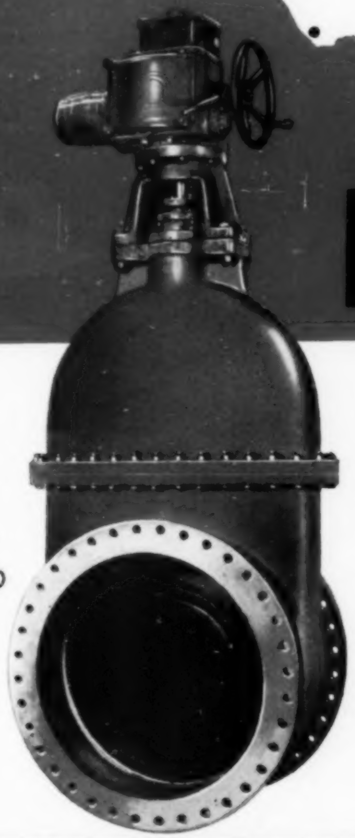

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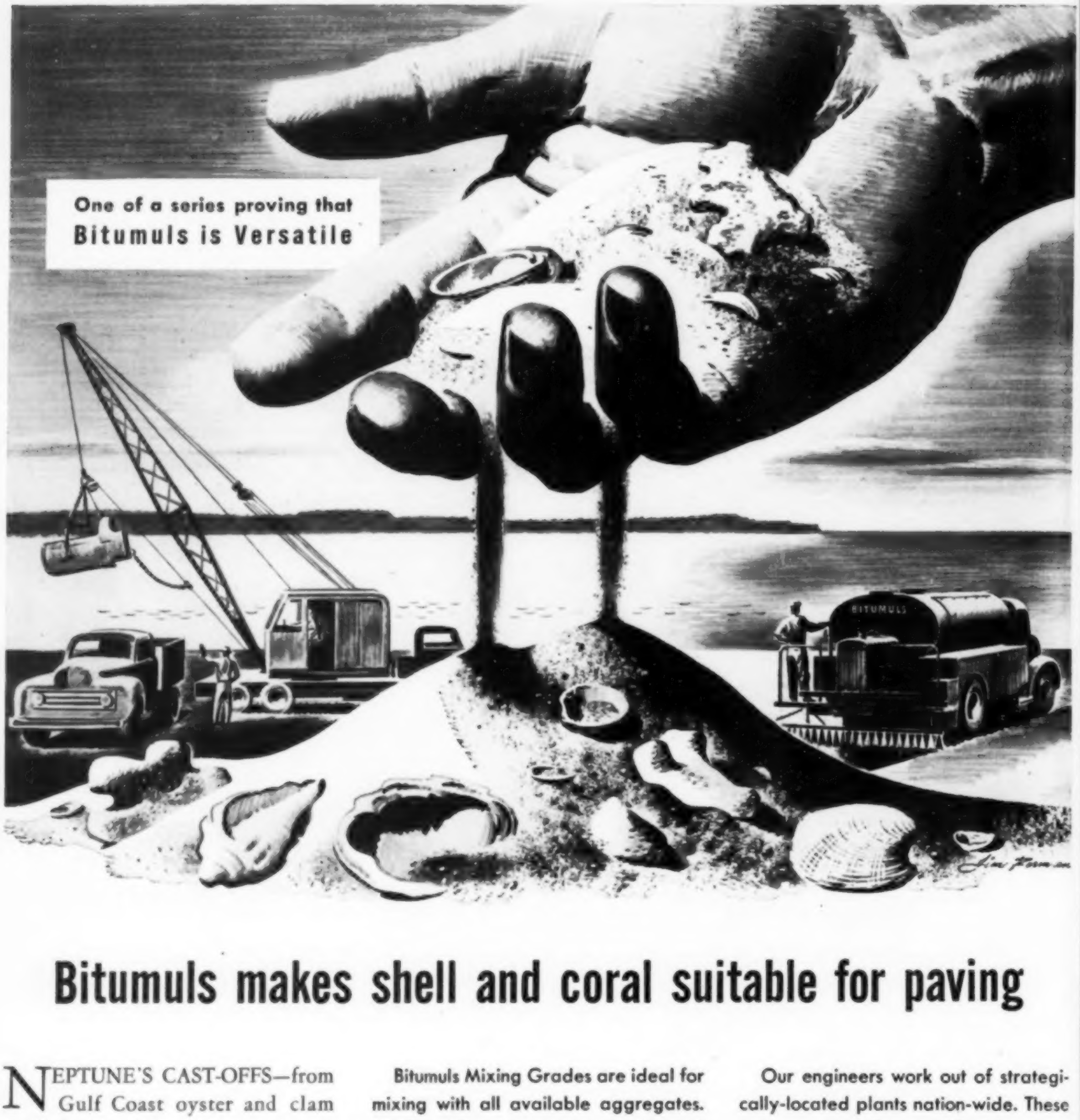

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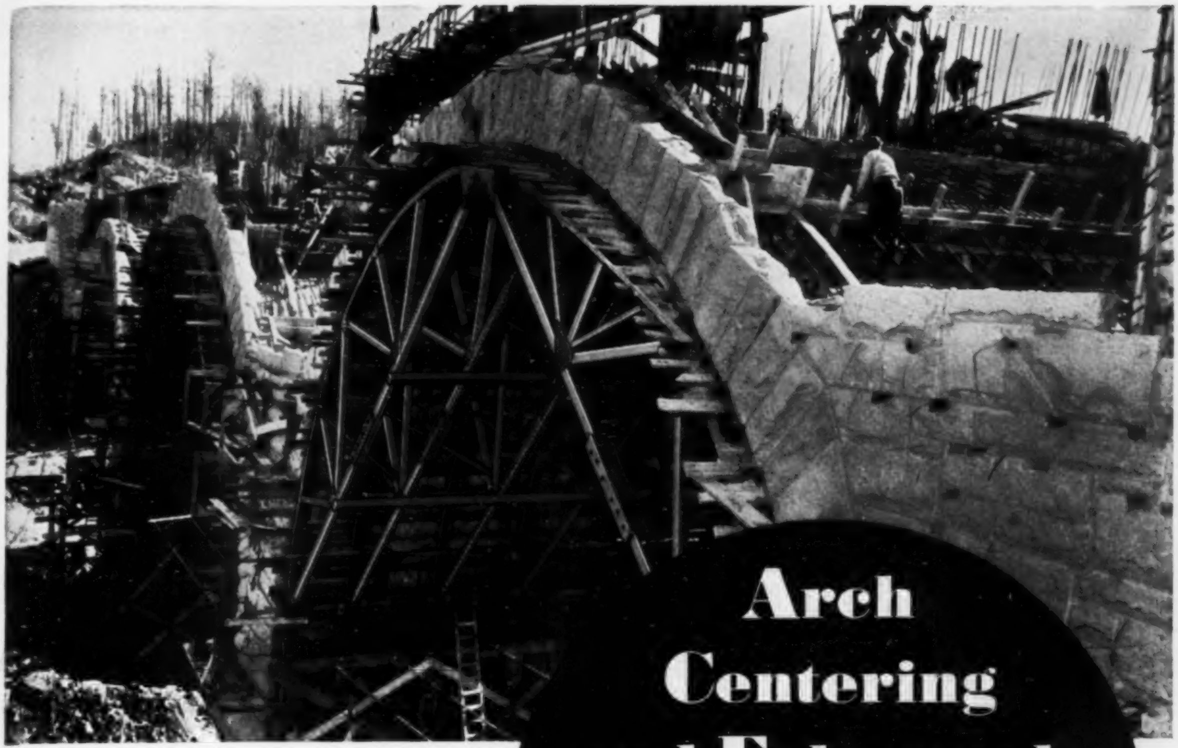

Bar Harbor triple arch bridge on Paradise Hill Road on the coast of Maine. Length 273 feet plus approaches; roadway width 24 feet, with 3-foot sidewalk on both sides. Design by Bureau of Public Roads.

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precision fabricated to save time and cut costs

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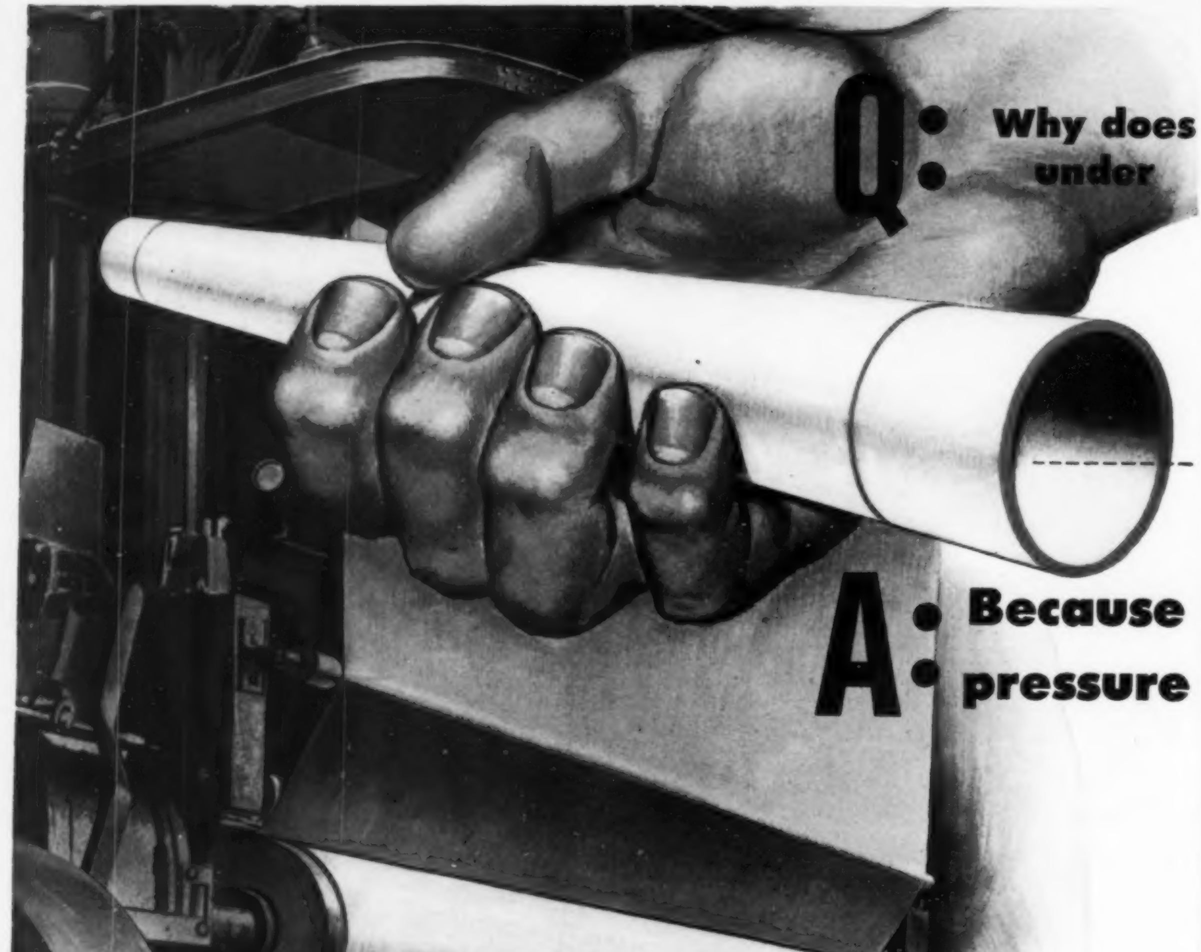

Above: On machines like the one sketched, Transite Pipe is formed under tremendous pressure exerted by hydraulically actuated pressure rolls.

*Transite is a registered Johns-Manville trade mark

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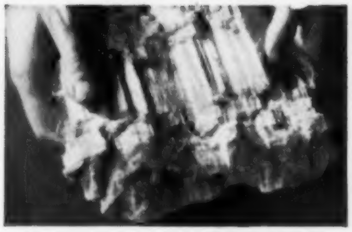
TRANSITE PIPE last longer these Texas city streets?

The water system in this fast-growing Texas city is a tribute to the lasting strength and corrosion resistance that enable Transite Pipe installations to outlast other pipe under busy city streets. The first Transite mains were installed here in 1939 to replace previously used pipe which had a service life of approximately seven years. So successful was this original installation that today, virtually the entire supply and distribution system consists of Transite mains.

it's formed under tremendous for lasting strength



Tough, strong asbestos fibers reinforce Transite Pipe—contribute to its exceptional corrosion resistance and lasting strength.

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And no wonder thousands of American cities and towns have found it the answer to today's need for a pipe that assures the greatest possible return on waterline investments. For in addition to those economies resulting from lasting strength, Transite Pipe also provides other important savings. Its light weight and easy handling reduce installation costs. Its tight, flexible Simplex Couplings cut down on costly leakage losses. Its smooth interior assures a high coefficient of flow (C=140) and, because Transite cannot tuberculate, helps keep pumping costs permanently low through the years.

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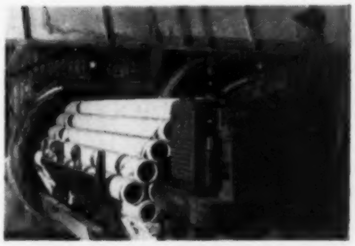
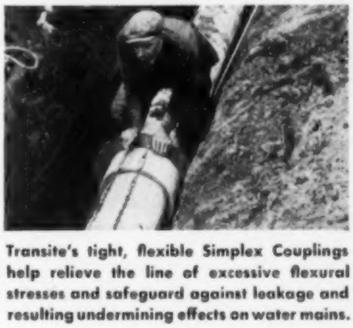


The pressure steam curing process—another reason why Transite Pipe survives corrosive attack and stays strong in service.



Transite's tight, flexible Simplex Couplings help relieve the line of excessive flexural stresses and safeguard against leakage and resulting undermining effects on water mains.

asbestos-cement PRESSURE PIPE

VOLUME 22

NUMBER 6

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JUNE 1952

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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IN THIS ISSUE

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NEWS BRIEFS

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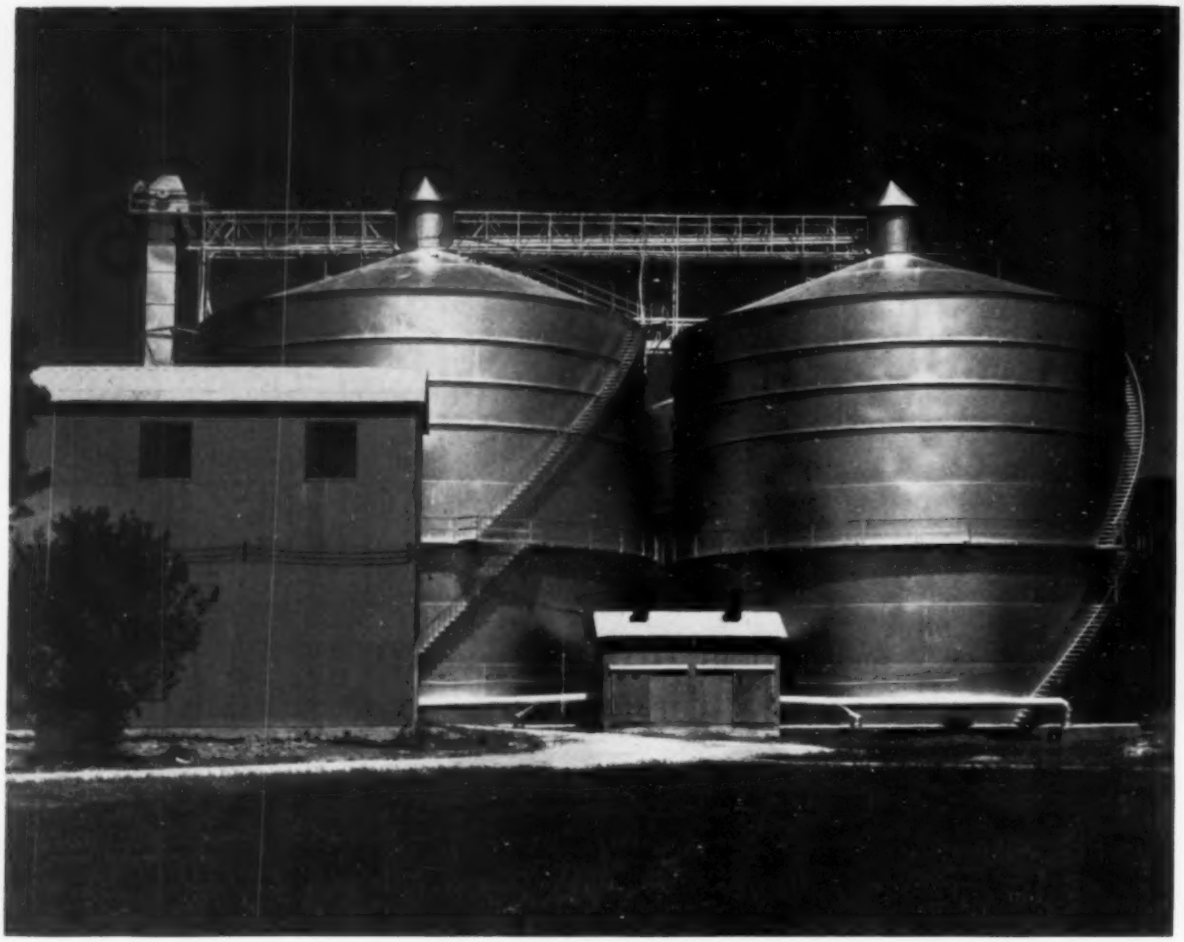
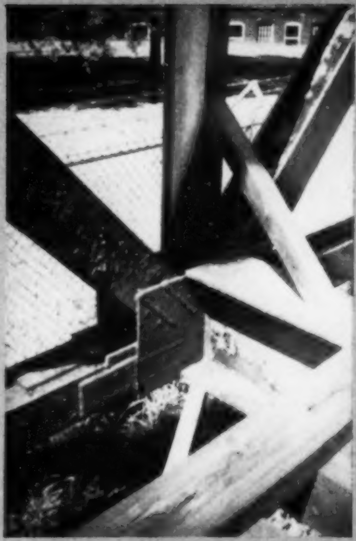


R. N. V. BRODIE, M. ASCE

Engineer of Structures, Boston & Maine Railroad, Boston, Mass.

First all-welded railroad span in United States, known as Chicopee Falls Bridge, was opened to traffic in 1928. Structure, a subdivided Warren, was designed by Gilbert D. Fish, M. ASCE, for design load of E50 plus 50 percent impact. Located on industrial sidetrack, bridge has remained in more or less continuous service although never subjected to sustained heavy traffic.



Are we ready for all-welded railroad bridges?

Although fusion welding has been in fairly general use for more than 25 years, a casual survey indicates little or no trend toward the use of all-welded railway bridges. In spite of the growing acceptance of welding for secondary members and structural accessories, it is clear that railway bridge designers have formidable objections to the extension of welding to the large and important components of their bridge structures.

The factors influencing fashions in bridge design are not numerous; the chief ones are probably contemporary esthetics, availability of new materials, changing types and volumes of traffic, growth in industrial resources, and relative economics. It is fair to say that railroad bridges, perhaps more than any other structures, reflect the economics of their time and place above all other factors.

The designer of a railroad bridge is charged primarily with the duty of giving his employer the most for his money. No matter what attractive and promising devices or processes appear on the horizon, he cannot afford to indulge in technical fads of whatever color, and he must be bound finally by the dictates of utility and function. The consequences of failure of even relatively unimportant railroad facilities are frequently fatal; therefore the railway bridge designer will not lightly cast aside the proven practices which have for many years brought Number 14 safely into the terminal on time. While not basically inhospitable to innovation, he is nevertheless constrained to proceed very cautiously in considering any departures from tested procedure.

What are the obstacles, then, in the way of progress toward the adoption of welding for railroad bridges? The major questions which disturb the designer of such structures may be summarized thus:

1. Will all-welded steel railroad bridges be safe?
2. If welded parts fail, will they give way gradually, or suddenly, without previous warning?
3. Will such bridges be more economical than other types?
4. Can they be built with existing fabricating shop facilities and available rolled shapes of structural carbon steel?
5. How can good welds be assured, in shop and field?
6. How can welds, especially large field welds, be tested nondestructively so as to disclose any internal defects?
7. What damage does welding do to the metal adjacent to the weld, and can such damage be controlled or corrected?
8. Are the characteristics of welded bridges as favorable for railroad traffic as are those of other types of bridges?
9. Do welded bridges offer advantages as to maintenance, alteration, or strengthening not present in other types?

No doubt these questions can be further subdivided, and others will occur to various engineers, but it is believed that the general adoption of all-welded railroad spans will stand or fall on the answers to the questions here outlined.

Safety, of course, is of paramount importance, and the record of failures in pioneer welded bridges, and more recently in welded ships, justifies the raising of this question. However, if the requirements indicated by the remaining questions are met, safety will be assured as a matter of course.

Manner of Failure. Designers of railroad bridges, in common with all other designers, hope to avoid failure of any part of their structures. Experience has shown that some riveted details are inherently weak and prone to local instability. Usually, however, signs of overstress appear long before failure, permitting correction before complete collapse occurs. It is important to know whether welded fastenings can be detailed so as to give some advance warning of approaching distress. In other words, the manner of failure is

just as pertinent as the probability of failure.

The designer visualizes, for example, a butt-welded splice in a main tension member, such as a bottom chord, a type of joint that comes well recommended from the research laboratory. Should such a joint develop a slight crack in one edge, it would tend to part suddenly, without further ado. This disturbing possibility, however remote, makes more research and experimentation with welded joint details seem advisable, not only from the standpoint of fatigue strength, but also from the practical viewpoint of detectable symptoms of failure. The endurance limit of a particular joint detail may be a less significant criterion than knowledge of how it will fail.

Relative economy is one of the most controversial factors in the situation, and one that will probably have the most decisive influence. Are welded railway bridges cheaper than riveted spans? There is only one way to answer this question at any given time and place. Alternate designs for both types of structure must be prepared and completely detailed, and bids must be requested on both. The slipshod practice of detailing one type and merely asking for an alternate bid on a loosely described alternative will seldom result in a valid comparison.

Contractors will usually bid lowest on the type of work they can do best, and few fabricating shops are equally well equipped for welding and riveting. Fabricating shops are interested in maintaining as high a tonnage output as the economic demand will support. Experience has shown that more men, more space, and more time are required to turn out an equivalent tonnage by welding than by riveting. Consequently bids from fabricators will generally tip the scales in favor of riveted designs.

There are, of course, many local shops that are well equipped to turn out welded structures, and no doubt favorable bids can be normally obtained on work within their capacity. Whether the shop be large or small, however, relative economy can only be determined by obtaining prices on properly bid alternate designs.

The trend of welding costs today, as compared with those for riveting, appears to be upward. The current trend toward higher labor costs has tended to penalize welding, with its somewhat higher proportion of skilled hand work as compared with riveting. While no unassailable conclusions can be drawn, conditions in the labor market today do not promise any marked economy in favor of fabrication by welding.

What of other possibilities for economy, such as weight saving, through the use of welding? Here the significant fact is that the railroad industry is long past the expansion stage. Railway bridge replacement has only to keep pace with obsolescence, depreciation and occasional line changes. Small annual tonnages of new bridge steel are involved, and a weight saving of 5, 10, or even 15 percent is less significant in this field than in fields where large tonnages are involved. Furthermore, other aspects of the weight-saving factor make it unattractive to railroad bridge engineers. One is the constant and unremitting battle against corrosion. Another is the greater ability of a heavier structure to absorb the impact and vibration characteristic of railroad loadings. Railroad bridge engineers are therefore reluctant to move in the direction of highly stressed lightweight structures. "We are building bridges," they say, "not airplanes, and far different qualities are required."

The economy of welded railway spans has still to be established, and it is unlikely that it will be extensively investigated until other technical objections have been overcome. If welded designs are shown to be more expensive than riveted ones, they will not come into general use regardless of other considerations.

Existing Production Facilities. It does not appear that there are any special requirements for welding heavy bridges which cannot be met by existing fabricating plants. If a heavy demand for large welded bridges develops, there is no reason to suppose that it will exceed the present resources of the steel industry. A review of the roster of welded highway bridges does not indicate that any marked changes in existing fabrication or rolling facilities would be required to produce bridges of this type. It is evident, therefore, that this element of the problem is not a major influence in the current attitude of railway bridge engineers.

Assurance of Good Welds. Testing of welds, and more significantly, of welders, are subjects extensively covered by the specifications of the American Welding Society and other specifications derived from these, including many building codes. The necessity for qualification of welding inspectors and welders, and for the more or less continuous supervision of welds in the making, have long been emphasized, and methods have been prescribed for ensuring good results.

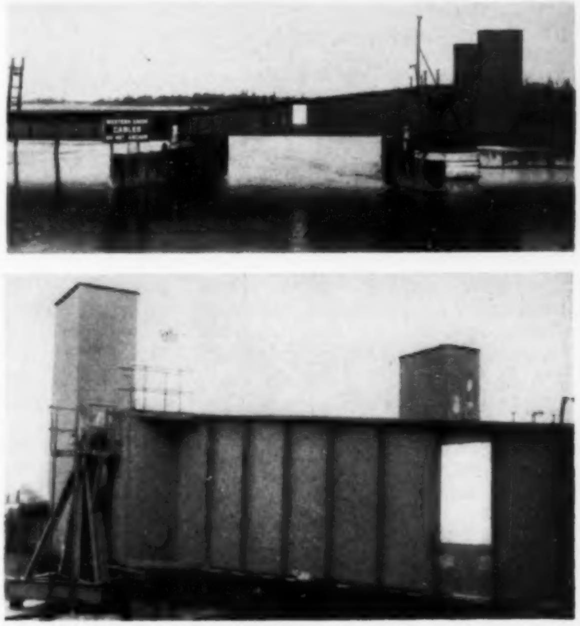
Notwithstanding these precautions, the railway bridge engineer requires still further assurance that the end product will be free from internal defects. He is not so much interested in statistical averages as in specific cases, and the fact that the welding process requires such unremitting vigilance by inspectors is not in itself a recommendation. Something more is needed, some device or method not now in general use, to overcome this distrust of a process which is so dependent on a consistently high level of manual skill. Naturally this anxiety need not, and does not, extend to all the welded connections in a structure. Many will perform efficiently if made in conformity with good average practice. It is only in the case of vital joints in main members that doubt obstructs further progress. Here again, the fear of hidden defects in large welds is tied in with the question of developing details that will give advance indications of failure.

Non-Destructive Tests. The use of radiographic and electrical variance methods for detecting internal faults in metal products is more extensive in the mechanical industries than in the structural. The practical difficulties impeding progress in the application of such methods to large structural members have still to be overcome, but there seems to be no doubt that development along these lines is necessary if the maximum use of structural welding is to be achieved. The simple test of making and breaking small welded specimens on the job does not furnish the proof that the railway bridge engineer desires, any more than does the mere surface examination of finished welds.

Such defects as internal cracks in weldments are amenable to detection by the magnetic flux and powder method, which is already in use in many railroad shops. The radiographic method of examination, using X-rays or gamma rays, is already well established, under coded procedures, in the pressure vessel industry. However, the high-voltage equipment required for radiographing heavy structural assemblies is bulky and requires a large investment, and the extension of its use would place welded work at a further economic disadvantage.

It is clear that some practicable non-destructive method of examining field welds as well as shop welds will have to be developed to assure a sound internal structure. When such a practice has become established, much of the doubt as to the

Through plate girder bridge in Syracuse County, New York, has welded plate floor and diaphragm details. Main members are riveted.



Only all-welded railway bridge in this country, as of June 1952, carrying high-speed main-line traffic, is double-track trunnion bascule seen in two views at right. Designed by Florida East Coast Railway and fabricated by McClintic-Marshall Corp., structure has been in service since 1935 with no defects or difficulties encountered to date.

physical quality of welds will disappear.

Damage in Heat-Affected Zone. Welding enthusiasts have frequently pointed out that welded connections fail in the base metal and not in the weld, unless they are deliberately proportioned to break in the weld. Most designing engineers are familiar with this phenomenon and its causes. The consequences of subjecting structural carbon steel to the intense local heat of fusion welding are somewhat complicated, but suffice it to say that in the metal adjacent to the weld, a decrease in ductility occurs, varying with the carbon content of the steel, the duration and intensity of the heat, rate of cooling, and other factors.

How can this tendency toward decreased ductility be controlled or minimized? First, by limiting the carbon content of the steel to an optimum amount which is a compromise between strength and weldability. Second, by preheating the base metal, so as to maintain a smaller temperature differential and retard cooling. Third, by subsequently heat-treating, or annealing, the affected parts. Another approach to the problem now under consideration is the adoption of a special steel for welded bridges.

The practical problem of annealing large welded members awaits the installation of adequate furnaces by fabricating shops. No doubt such installations await sufficient demand, but if annealed members could be offered at reasonable cost, another source of distrust might be removed.

Traffic Characteristics. It is doubtful if all the evils of repetition and reversal of stress, vibration, impact, and lateral forces are so destructively combined in any structure as in the railroad bridge. If any stress-raisers or inadequate details have escaped the designer's attention, they are sure to show up sooner or later under the sustained pounding of train traffic. No laboratory project within the bounds of reason or available resources can duplicate the actual conditions of such exacting service. Long years of contending with the grievous practical problems of maintenance have taught the railway bridge engineer where to look for weakness in details, and perhaps he should be forgiven for doubting that welded details are as impact absorbent, as vibration resistant, and as flexurally adaptable as the multiplex units of riveted and bolted joints.

Notwithstanding these hazards, if the "gradual-failure" type of welded detail can be developed, the characteristics of railroad loadings are not sufficient in themselves to prevent the ultimate use of all-welded spans for railroad bridges.

Alteration and Maintenance. Taking into account the possibilities of cleaner design, there may be some incidental benefits for the maintenance department in welded bridges. There is, of course, room for improvement in this direction in riveted structures, but the tendency toward simplification is less evident at present in this design field. Painting especially may prove to be simpler, and hence cheaper, on welded structures.

When the renewal of members under traffic is considered, riveted connections seem to have the advantage. As for ordinary repairs or strengthening by the addition of details, there may be some advantage in the absence of rivets.

By and large, welded railroad bridges do not appear to offer sufficient advantages as far as maintenance, alteration or strengthening are concerned to decisively influence the type of bridge chosen for railroad use.

This brief discussion indicates the extent of the zone of uncertainty surrounding all-welded railway bridges. Designers of railway bridges seem to be justified in demanding more assurance of security and economy than can at present be given before they accept such structures for general use.

Although opportunities for favorable comparison of welding with riveting seem to be receding as the materials situation arising from the national emergency becomes more serious, pessimism regarding the ultimate adoption of welding for railroad bridges is unwarranted. When and if sufficient advantages can be demonstrated, all-welded railway spans will probably become common. In the meantime such construction is likely to remain in the category of projects awaiting further research.

AASHO recommends higher salaries for highway engineers

Report of November 1951 on Classification and Minimum Compensation

D. C. GREER, M. ASCE

Chairman, Committee on Administrative Practices of AASHO; Past President, AASHO; State Highway Engineer of Texas, Austin, Tex.

Employment in the public service has a number of advantages, but excessive monetary compensation for services rendered has never been one of them. Observing the low salaries of engineers employed in state and local highway departments, the Executive Committee of the American Association of State Highway Officials early in 1946 named a Special Committee on Salaries and Wages in Highway Departments, made up of leading state highway engineers under the chairmanship of the writer.

This committee made an intensive study of the classification and compensation of highway department employees and, at the annual meeting of the Association in Los Angeles on December 16, 1946, submitted the first report. The report was made available for study by 44 state legislatures convening in January of 1947, and was widely circulated and enthusiastically received by engineering department personnel engaged in federal, state, county and municipal highway work. Substantial improvement in the salary schedule of many departments resulted during 1947.

At the annual meeting of the Association held in New York in September of 1947, the same Special Committee submitted its final report, which recommended that the duties of the Special Committee be transferred to the jurisdiction of the permanent Standing Committee on Administrative Practices, likewise under the chairmanship of the writer. Both the interim and the final report continued to have substantial circulation and use during the following three years. Salary conditions of highway department personnel continued to improve even though the improvements were spotty in character during these years.

During 1949 and early 1950 it seemed that the cost of living index would shortly become stabilized. However, that hope proved false. By late 1950 it was apparent that living costs were on the increase again, and highway department salaries in most instances were not sufficiently flexible to keep pace with these changing conditions. At the annual meeting of the AASHO in Miami, Fla., in December 1950, the Executive Committee instructed its Standing Committee on Administrative Practices to review the previous salary report and bring it up to date, and to make its revised report available for consideration at the annual meeting of the Association to be held in Omaha, Nebr., in October 1951.

After making a new study, the committee submitted its report for consideration at the Omaha Annual Meeting, which authorized the writer as chairman to forward it promptly to the member highway departments. The committee's findings and conclusions with respect to professional employees, printed below, show the qualifications for technical and professional engineering grades, and the minimum compensation recommended for them by the AASHO.

A companion study, initiated by the Highway Research Board early in 1946, was published as Bulletin No. 9, entitled "Salary and Wage Practices of State Highway Departments." Copies are available from the Highway Research Board of the National Academy of Sciences in Washington, D. C. This study showed that state highway departments employ approximately 14,000 professional, and 14,000 subprofessional engineers.

In 1951 the AASHO, by canvas of the state highway departments only, found the annual average number of employees to be as follows: Professional engineering and technical employees, 42,000; subprofessional employees, 42,750; hourly-wage employees, 95,500; and highway contractors' employees, in all categories, 135,000—a total 315,250. No employment at the county, city, or local level is included in these figures.

For the year 1951, the 48 state highway departments were responsible for the supervision and expenditure of about 2.5 billion dollars of highway funds, of which approximately 1.6 billion was for new highway construction. These figures reflect the importance of the highway engineer's work in our national economy and emphasize the importance of adequate compensation for such services, not only to insure the retention of competent personnel in state highway departments, but also, and more importantly, to attract competent young engineers to the field of highway engineering. It is toward these ends that the AASHO is working.

AASHO Grade Specifications for professional engineers in highway departments

Group 8, Professional

Description and Duties: Under general direction of the State Highway Commission, to have entire charge and responsibility for the organization comprising the Highway Department who shall be the State Highway Engineer.

Minimum Requirements: Graduation with a degree in engineering from an approved engineering school plus at least twelve (12) years of broad and progressive professional engineering experience as evidenced by a detailed knowledge of engineering principles and their application; ability of the highest order in organization, direction and coordination of difficult engineering activities, particularly pertaining to highways. Registration as a Professional Engineer.

TABLE I. Salary Schedule

For Professional Engineers in Highway Departments, Recommended as Minimum by AASHO—1951

AASHO Group	Salary Range Recommended by AASHO in 1946	Salary Range Recommended by AASHO in 1951
Group 8	$10,000 up	$15,000 up
Group 7	8,180-10,000	9,000-10,500
Group 6	7,105- 8,060	8,000- 9,000
Group 5	5,905- 6,863	6,400- 7,800
Group 4	4,902- 5,905	5,000- 6,000
Group 3	4,150- 4,902	4,200- 5,000
Group 2	3,397- 4,150	3,600- 4,200
Group 1	2,645- 3,397	3,000- 3,600

Group 7, Professional

Description and Duties: Under general direction of the State Highway Engineer, to be in responsible professional and executive charge, individually, or with subordinates, of a particularly important major division or department of the highway organization involving planning, designing, construction, testing, administration, maintenance, etc.; to give independent critical or expert advice in all matters pertaining to the above described functions; to correlate the work of that division with that of other divisions or districts and to keep the State Highway Engineer informed on progress of matters under their supervision; to perform the usual duties of heading up a major division or department of a large state highway organization, as Deputy State Highway Engineer, Assistant State Highway Engineer, Chief Division Head, Engineer-Manager, etc.

Minimum Requirements: Education equivalent to graduation from an approved engineering school plus about ten (10) years of broad and progressive professional and administrative engineering experience as evidenced by a detailed knowledge of engineering principles, practices, and methods and their application; ability of the highest order in organization, direction and coordination of difficult engineering activity, particularly pertaining to highways; or education equivalent to completion of high school plus sixteen (16) years* of progressive experience in highway engineering and administration, supplemented by extensive study and reading in the field of highway engineering. Approximately fifty per cent (50%) of experience shall have been spent in lower grades of highway organization. Registration as a Professional Engineer for those employees carrying engineering titles.

Group 6, Professional

Description and Duties: Under general direction of the State Highway Engineer, to be in responsible professional and executive charge, individually, or with subordinates, of a division or district of the highway organization, involving planning, designing, construction, testing, administration, maintenance, etc.; to give independent critical or expert advice in all matters pertaining to the above described functions; to correlate the work of that division with that of other divisions or districts and to keep the State Highway Engineer informed on progress of matters under their supervision; to perform the usual duties of Division Head, District Engineer, etc.

Minimum Requirements: Education equivalent to graduation from an approved engineering school plus at least ten (10) years of broad and progressive professional and administrative engineering experience as evidenced by a detailed knowledge of engineering principles, practices and methods and their application; ability of the highest order in organization, direction and coordination of difficult engineering activity, particularly pertaining to highways; or education equivalent to completion of high school plus sixteen (16) years* of progressive experience in highway engineering and administration supplemented by extensive study and reading in the field of highway engineering. Approximately fifty per cent (50%) of experience shall have been spent in lower grades of highway organization. Registration as a Professional Engineer for those employees carrying engineering titles.

Group 5, Professional

Description and Duties: Under general direction individually, or with subordinates, to perform particularly important engineering work in field, office or laboratory requiring specialized engineering qualifications or attainments and offering wide latitude for independent action and decision; to be in responsible charge of a subdivision of a large organization; or to plan, direct, and supervise the design and construction of engineering projects, or to act as Assistant District or Division Head and be capable of acting in their absence; to perform the usual duties of Senior Resident Engineer, Senior Designing Engineer, Senior Laboratory Engineer, Assistant District Engineer, etc.

Minimum Requirements: Education equivalent to graduation from an approved engineering school plus at least six (6) years of progressive professional and administrative engineering experience as evidenced by a detailed knowledge of engineering principles, practices and methods and their application; to be able to organize, direct, and coordinate activities of a subdivision or group; or education equivalent to completion of high school plus fourteen (14) years* of progressive practical experience in highway engineering and administration supplemented by extensive study and reading in the field of highway engineering. Approximately fifty per cent (50%) of experience shall have been spent in lower grades of highway organization. Registration as a Professional Engineer for those employees carrying engineering titles.

Group 4, Professional

Description and Duties: Under general supervision, to be in charge individually, or with subordinates, of major engineering work or the supervision of a division or group of a larger organization requiring technical knowledge and experience; to plan, direct and supervise the design or construction of engineering projects; to make comprehensive research; supervise testing; to be responsible for operations of his division or group; to perform the usual duties of Resident Engineer, Designing Engineer, Soils Engineer, Research Engineer, etc.

Minimum Requirements: Education equivalent to graduation from an approved engineering school plus at least four (4) years of professional and administrative engineering experience as evidenced by a detailed knowledge of engineering principles, practices and methods and their application; to be able to organize and direct minor group or division; or education equivalent to high school plus twelve (12) years* of progressive practical experience in highway engineering and administration supplemented by extensive study and reading in the field of highway engineering. Approximately fifty per cent (50%) of experience shall have been spent in lower grades of highway organization. Registration as a Professional Engineer for those employees carrying engineering titles.

Group 3, Professional

Description and Duties: Under general supervision to be in charge individually, or with subordinates, of important engineering work in field, office or laboratory, requiring independent action and decision; to supervise and be responsible for small groups; to check designs; to lay out and inspect construction; conduct minor research, tests of material or processes; to perform the usual duties of District Office Engineer, Associate Resident Engineer, Chief Inspector, Associate Designing Engineer, Associate Laboratory Engineer, Senior Draftsman, etc.

Minimum Requirements: Education equivalent to graduation from an approved engineering school plus at least two (2) years of progressive experience in highway engineering work and possess a general knowledge of engineering principles, practices and methods and their application; or education equivalent to completion of high school plus eight (8) years* of progressive practical experience in highway engineering and administration supplemented by extensive study and reading in the field of highway engineering. Approximately fifty per cent (50%) of experience shall have been spent in lower grades of highway organization. Registration as Professional Engineer for those employees carrying engineering titles.

Group 2, Professional

Description and Duties: Under immediate or general supervision to perform moderately difficult engineering work in field, office, or laboratory; to supervise and be responsible for small groups on routine engineering work; to make and check working drawings, simple designs, details and estimates; to inspect minor construction, make routine tests of materials or processes; to perform the usual duties of Draftsman, Engineering Assistant, Senior Inspector, Senior Laboratory Assistant, etc.

Minimum Requirements: Education equivalent to graduation from an approved engineering school; or education equivalent to completion of high school plus two (2) years* of progressive practical engineering and administration supplemented by extensive study in the field of highway engineering. Approximately fifty per cent (50%) of experience shall have been spent in lower grades of highway organization.

Group 1, Professional

Description and Duties: Under immediate or general supervision, to perform minor engineering work in field, office or laboratory requiring knowledge of engineering practices and methods but with little opportunity for independent action or decision; to make minor surveys or working drawings; to inspect simple construction; to make simple routine material tests; to make simple drawings and tracings; to perform the usual duties of Instrumentman, Junior Inspector, Junior Draftsman, etc.

Requirements: Education equivalent to graduation from an approved engineering school; or education equivalent to completion of high school plus preferably one (1) year* of practical experience in highway engineering, fifty per cent (50%) of experience having been spent in lower grade.

* Each year of College or Specialized training in the same field as line of employment shall be counted as one (1) year of experience

How to build against atomic attack

ASCE has long been aware of the importance of civil defense and has felt that the value of the Society's assistance can be made most effective at the Local Section level. At the National Civil Defense Conference held in Washington, D.C., May 7 and 8, 1951, President Hathaway designated me as the representative of the Society. On this occasion, nearly 2,000 delegates were in attendance from all over the United States, and the President of the United States was the principal speaker.

Seven months before this conference, all ASCE Local Sections were circularized and urged to organize themselves for civil defense, and through a questionnaire were requested to advise Society headquarters of the nature and extent of their activities. As a con-

Shelter is the engineer's job

JAMES T. MARTIN

Deputy Assistant Administrator, Technical Operations Office, Federal Civil Defense Administration, Washington, D.C.

THE Federal Civil Defense Act of 1950 provides for the construction or preparation of shelters and shelter areas, and authorizes matching-fund contributions by the Federal Government to the states for that purpose.

The purpose of the Shelter Program of the Federal Civil Defense Administration is to safeguard our most respected weapon, the American people, whose ability to produce materials and equipment required for national defense is of first importance to our survival as a nation. The importance of accomplishing a shelter program is equal to that of providing attack warnings and is basic to the total civil defense program in that these complementary programs are the only means of reducing casualties. The shelter program is a real challenge to civil engineers.

This nation could be attacked at any time. We do not know their intentions, but we do know that the Russians have sufficient long-range high-speed bombers to deliver atomic bombs to practically all parts of the United States. Also, we know that even with the finest Air Force and air surveillance system in the world we cannot provide absolute protection against an air raid—an appreciable percentage of enemy bombers will get through. This should be sufficient reason for us to take immediate action and prepare for the protection of our population.

It is possible to design shelters capable of withstanding the maximum effects of an air-burst atomic bomb. However, it is unrealistic, at this time, to provide such absolute protection because of the great requirements for both materials and manpower. It is also impractical to embark on a shelter program, now, which would provide shelter for the entire population of the country. Shelter protection should be provided where needed in the maximum amount feasible and in the minimum of time consistent with the material and the manpower requirements of the national economy.

The foreseeable problems are many and difficult and of such a nature that they cannot be solved overnight. In formulating the program, we had to ask ourselves the following questions:

What is shelter?

Who should have it?

How much do we need?

How much is in existence?

Also, certain assumptions had to be made, the principal ones being as follows:

1. The enemy's chief weapon will be an atomic bomb, but the capabilities of other weapons are recognized and are considered in our program.
2. The most likely targets are the concentrated areas of large commercial and industrial cities, the motive being to cause thousands of civilian casualties.
3. The interval between the sounding of a warning to the general public and the actual explosion of the bomb would be five minutes.
4. There would be no pre-attack evacuation of our cities.

Our initial efforts were directed towards development of a technical standard providing for examination of existing buildings to determine their shelter capabilities as well as for the determination of shelter requirements. At the same time we were developing standards that would enable us to offer a series of technical manuals encompassing the entire field of protective shelter. These technical manuals provide design information for the improvement of shelter areas within existing buildings, interim information for the design of buildings exposed to blast loadings, and information on the design of windowless structures, as well as on the design of protective construction such as public and home-type shelters.

One of the most pressing problems since the very beginning of the program has been our inability to secure the services of necessary key technical personnel. I refer particularly

sequence, it was possible at the time of the conference to supply Federal Civil Defense Administrator Caldwell with a report on what ASCE had done and was planning to do. At about the same time the Board of Direction appointed me, as Contact Member of the Committee on Local Sections, to serve as liaison official with the FCDA.

Last fall George Cunney, of the Shelter Division of the FCDA, discussed with me measures to effect fuller cooperation of ASCE members in the FCDA program to provide shelter areas and to assist in the inspection of structures from the standpoint of their suitability as shelters. The panel discussion on civil defense at the Society's New Orleans Convention, here reported, resulted largely from these conversations. Administrator Caldwell offered to assist in preparing the panel program and designated Mr. Cunney and Robert S. Holmes, of the Administration's Engineering Division, for liaison work with us.

Civil engineers have the training and experience, and many are directly employed in fields of endeavor, which make them of great value in civil defense programs. Many of our Local Sections have civil defense committees working with the local civil defense authorities. A substantial percentage have reported participation in surveys of shelter areas, a field of activity in which ASCE members can be particularly helpful.

FRANK L. WEAVER, *Director, ASCE Board Contact Member, Committee on Local Sections*

Washington, D.C.

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to the need for the professional engineer who has the special experience which equips him with the ability to translate research results into factors that can be readily accepted and used.

Considerable data are now available but a great deal more must be developed concerning the effects of atomic weapons. Here is an opportunity for the engineer to render a great service to his country.

In order to provide, immediately, as much shelter as possible, first attention is being given to shelter areas within existing buildings. Of course, the best American buildings generally will not provide as good protection as would a specially designed bomb shelter, but they do afford varying degrees of protection. We are now initiating surveys in the major cities within critical target areas to determine the shelter need and the percentage of this need that can be accommodated by existing structures.

Members of our staff have visited many cities and assisted in the initiation of surveys in them. Of course, in all cases the cities must rely on the voluntary efforts of engineers to carry out the surveys. Without the voluntary help of the engineering profession shelter areas cannot be determined, and even a partial percentage of the population cannot be protected. While the voluntary aid of the engineer is needed to survey existing buildings and to ascertain their shelter adequacy, other phases of the engineering work involved in the program will be done on a fee basis. Among these would be preliminary planning for the improvement of existing structures and for the construction of new structures. A request for $6^1/_2$ million dollars of matching funds is now before Congress to defray the Federal Government's share of these preliminary engineering costs.

Following this preliminary study would come the preparation of plans and specifications based on the preliminary engineering work, and then the actual construction work. For this second phase, which we can call the engineering and construction phase, we have requested \$243,500,000, which also is to be used on a matching-fund basis.

FCDA Shelter Program

The following steps are required:

1. Determine the amount of shelter needed.

2. Appraise existing buildings to determine the availability of shelter.

3. Offer methods of strengthening existing buildings in order to provide suitable shelter areas.

4. Provide for the design and construction of public single- and dual-purpose shelters.

Design of protective structures briefed

A. S. NEIMAN, A. M. ASCE

Acting Chief, Technical Standards and Review Branch, Shelter Division, FCDA, Washington, D.C.

The Federal Civil Defense Administration is proceeding analytically as well as empirically with the development of technical standards for the design of protective structures and particularly shelters. The design of such structures, like the design of all others, must be based on a number of assumptions. This article will be limited to protection against the effects of an atomic bomb detonated in the air at a height such that maximum damage will result.

The primary effects of an atomic explosion that we must protect ourselves against are—blast, heat and nuclear radiation.

Blast effect is due to the rapid expansion of the heated air around the bomb. This creates a blast

wave which travels in all directions from the point of detonation with a speed somewhat greater than the speed of sound. Heat, which accounts for about one-third of the energy released, travels in straight lines with the speed of light and lasts for but 2 or 3 seconds. The nuclear radiation also travels with the speed of light but differs from thermal radiation because of its high penetrating power. It lasts for about 100 seconds with a varying degree of intensity. To protect against flash heat, all that is needed is some clothing; to protect against nuclear radiation, what is needed is sufficient material with enough density to attenuate the rays to the point of harmlessness.

Secondary effects are fire, flying missiles and entrapment by debris.

Fires can be started by flash heat, which is sufficient at ground zero for a nominal size or 1X bomb (Nagasaki type, equivalent to 20,000 tons of TNT) exploding at 2,000 ft to create a temperature of 3,000 deg C. This can ignite wood, cloth, paper and similar objects. The temperature decreases with distance, but it still can ignite paper at two miles. A hideous aspect of fire is the possible development of a fire storm from closely spaced individual fires started from knocked-over furnaces, short circuits, and broken gas lines in a built-up area of combustible buildings.

The Federal Civil Defense Administration has completed three manuals, which will be available on request to the Superintendent of Documents, Washington, D.C.:

1. "Shelter from Atomic Attack in Existing Buildings—Part I, Method for Determining Shelter Needs and Shelter Areas." This manual gives the methods and procedure for determining the number of people that can be suitably sheltered in existing buildings and the criteria for selecting shelter areas within such buildings.

2. "Shelter from Atomic Attack in Existing Buildings—Part II, Improvement of Shelter Areas." This manual indicates how existing buildings can be improved to eliminate existing hazards so as to increase the available supply of suitable shelter.

3. "Interim Guide for the Design of Buildings Exposed to Atomic Blast." This is a technical publication containing minimum standards and criteria for the design of structures subject to atomic blast. Structures designed by these standards are considered to have a reasonable chance for survival at a distance of 1/2 mile from ground zero.

NOTE: The basic data contained in manuals Nos. 1 and 2 are based on the reports made by Lehigh Institute of Research and the Bureau of the Census. Manual No. 3 is based primarily on material contributed by Dr. Robert J. Hansen, of the Massachusetts Institute of Technology, and Dr. Merit P. White, of the University of Massachusetts, in cooperation with Sherwood B. Smith, Department of Defense.

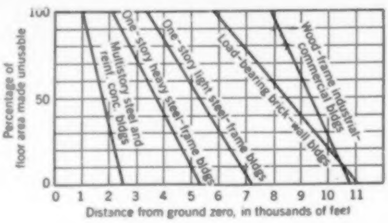


FIG. 1. Resistance of standard-type buildings to damage by atomic bomb explosion is indicated by curves.

TABLE I. Recommended Design Live Loads for Blast

WHERE APPLIED	EQUIVALENT STATIC LOAD, IN PSF
Structure as a whole (framing, vertical and horizontal bracing, footings, etc.)	90 on vertical surfaces; 70 downward on roof
Roof and ground floor (slabs and beams) (See Sect. 2.5.1)	100 vertically downward; 70 upward
Other floors (except shelter area)	70 from either side
Walls, interior and exterior (except exterior of shelter areas and those walls expected to fail)	150 from either side
Slab covering stair well or elevator shaft	150 downward

Selecting Shelter Areas

As its title indicates, the first manual describes methods for determining shelter areas in existing buildings and presents a system for rating such areas. This system, developed as a simple means of comparing potential shelter areas, is being used nationally as part of a comprehensive survey method for collecting information on the characteristics of buildings; for rating shelter areas on the basis of this information; and for determining the number of people needing shelter in a given block at a given time. The system makes it possible to place shelter areas in one of four categories on the basis of the sum of the scores assigned to individual features.

Existing buildings obviously afford some degree of shelter. A structural steel or reinforced concrete building is the safest. Some areas within buildings are obviously better than others. Any area selected for a shelter should be in the "core" of the building, away from outside exposure. Desirable characteristics of the shelter area are listed in the box (facing page). While very few areas will have all these characteristics, the area selected should fulfill these requirements as nearly as possible.

A scoring system was developed by means of which some degree of uniformity can be secured in rating existing buildings and the shelter areas with them in terms of their ability to withstand the effects of an atomic explosion and to protect the people in them. It is imperative that technically trained professional people investigate shelter areas which do not possess all these desirable characteristics.

The second manual, called "Improvement of Shelter Areas," gives suggestions for increasing the number of suitable shelters. It is concerned chiefly with deficiencies in shelter areas and describes some means of eliminating such deficiencies.

It should be stated that the resistance of existing types of American buildings to an atomic explosion as well as the resistance of their component structural parts has not been completely determined. Additional test data are needed to establish the blast loading as well as the response of the structural elements.

Shelter areas in the basements of wall-bearing buildings have been given careful consideration inasmuch as such areas may be the only ones that are suitable. If the following two conditions do not exist, it may not be economical to improve the basement of a wall-bearing building so that it can be used for shelter.

1. The exterior basement walls in every direction should be at least 80 percent below ground level.

2. The building should be tall enough to offer adequate shielding from initial gamma radiation by aggregate thickness of floors and roof above the shelter, or should be shielded by other buildings.

The manual describes methods of strengthening the shelter roof and of installing debris-supporting and protected exits.

When it is necessary to strengthen the floor serving as the shelter roof, the various floor members can be strengthened by placing intermediate supports to shorten their spans. For the design of the floor which forms the roof of the shelter area, the following design loading for debris is recommended:

STORIES ABOVE SHELTER	DESIGN LOAD FOR DEBRIS
2	200 psf
3–4	300 psf
More than 4	400 psf

These design loadings include a factor for impact.

Desirable Characteristics of Shelter Areas

1. The area selected should be in a part of the building that is structurally compact with a close spacing of columns and short-span floor beams.

2. The selected area should have at least three floors above it for overhead protection and at least two walls for lateral protection.

3. The area should be out of direct line with doors, windows and hallways having exposure to the outside.

4. Walls and doors immediately surrounding the area should be free of glass.

5. There should be at least one interior stairway within each selected area or near it—not adjoining an outer wall.

6. The area should not contain furnaces or boilers, or large steam, water, or gas pipes.

7. The ceiling of the area should not be of the hung or suspended type and it should be free from heavy hanging lighting fixtures or plaster ornaments.

8. The floor directly above the area selected should not carry any unusually heavy concentrated loads.

9. The area should be as unobstructed as possible with furniture, stored merchandise and equipment.

It is recommended that all allowable unit stresses used for design be obtained by doubling the current allowable stresses as found in nationally recognized standards and codes, provided that the yield point of the material is not exceeded.

For compression members the allowable stresses must not exceed those that will cause primary or secondary buckling.

Window glass will be broken over a very large area surrounding ground zero—possibly 200 sq miles. This glass will be projected at high velocities and can cause serious casualties. The danger to persons sheltered, say, in a corridor, can be lessened by replacing the glass with panels of inexpensive soft fiber-board which will fail by tearing rather than by shattering.

Blast Loading Important

By far the most important effect from the viewpoint of the structural designer, is the blast loading. In fact, it is the determining factor in considering the survival of structures. The third manual, "Interim Guide for the Design of Buildings Exposed to Atomic Blast," is concerned with reducing vulnerability by increasing the resistance of new buildings, or additions to old buildings, to the blast loading so as to provide a reasonable chance for survival.

Mechanical energy released by the bomb produces a powerful pressure wave which travels radially out from the center of detonation and envelops all objects in its path. The effect of this pressure on a building is equivalent to a heavy blow followed by a steady pressure, first on the side of the building toward the explosion, and then, as the blast wave passes by, on the remaining sides and roof. This is equivalent to a giant squeeze on the structure. After the front of the blast wave has passed, there remains a drag force directed away from the point of explosion due to the strong wind that follows the shock front. This drag force decreases to zero when the pressure becomes zero. Then, during the suction phase, the steady force on the building reverses direction and acts toward the point of detonation.

Buildings designed to resist blast should have the ability to resist lateral loads, to deform plastically, and to resist fire.

The percentage of damage, as measured by the floor areas made unusable at various distances from ground zero for various types of buildings, is shown in Fig. 1. These data are based on the damage at Hiroshima and Nagasaki. The graph shows that, for complete safety even at one-half mile from a point under the bomb, a high steel or concrete building is required.

The pressure inside a conventional building is generally less, but not much less, than the pressure applied to its front wall. The inside pressure may act for a longer period than the external pressure and in addition may be reflected in such a way as to be sometimes larger than the external pressure. This phenomenon explains why walls of buildings frequently fall outward when subjected to blast.

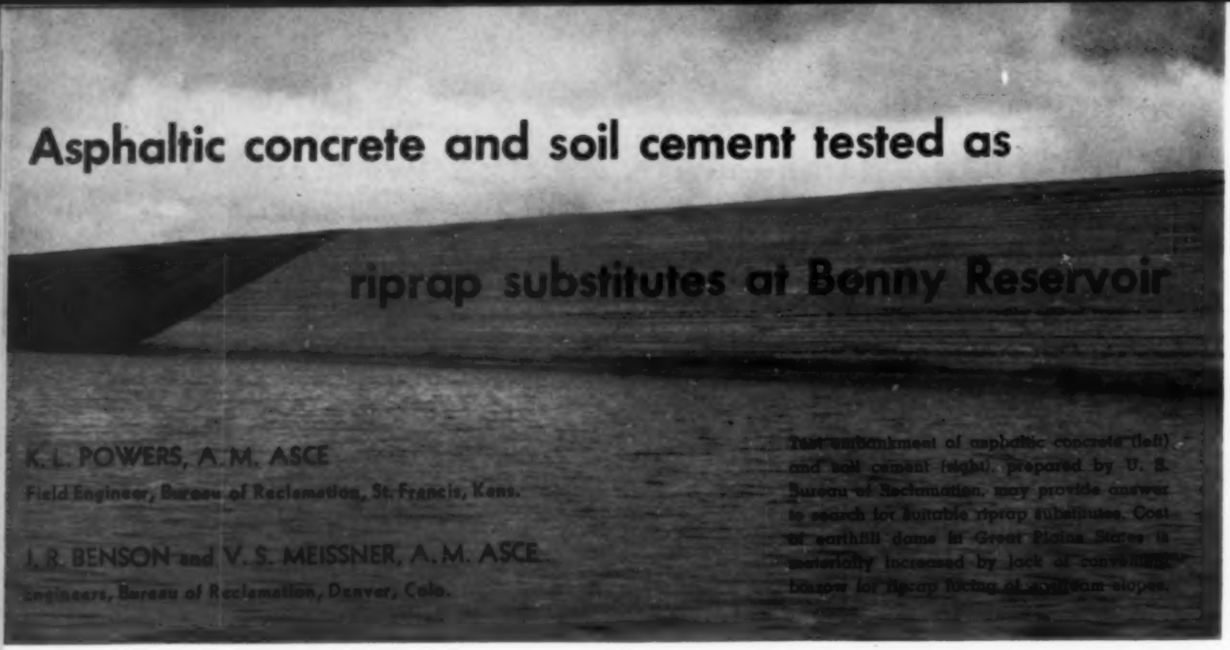
The decision as to the best kind of wall or partition will depend mainly on the function of the structure and on its type. If the contents need no special protection from the blast or from the elements it may be more economical to use light, breakable walls and partitions which can be replaced easily and cheaply. In this case the frame of the building needs only to be strong enough to withstand the breaking force of the panels and the forces that the blast, and the wind following it, exert on the members of the frame. On the other hand, if the contents need protection, it is best to design the walls to remain in place. The rest of the structure—floors, transverse walls and frame—must be capable of resisting the loads that will be applied. Resistant walls not only increase the loading on the frame but serve as shear walls to resist blast loads from the other directions.

In summary, this manual gives the following conclusion: The resistance of buildings to blast loads can be improved in most cases by various simple and relatively inexpensive measures. The principal criterion is to obtain reasonably consistent strength for the various elements of a structure and for the structure as a whole.

Structures designed for adequate resistance to blast loads (Table I) are expected to have a reasonable chance of survival at distances more than one-half mile from a Nagasaki-type atomic bomb (equivalent to 20,000 tons of TNT). If the resistance is provided by shear walls, damage will be greatly reduced. The complete design of the structure must be based on a combination of blast load and dead load, as well as on the other combinations of loading specified by the applicable building code. For the blast-plus-dead-load combination, use allowable stresses specified for wind.

The cost of construction that will provide this protection will depend among other things on the size of the bomb, the assumed distance from the explosion, and the degree of damage that can be tolerated in the structure. Several structures were designed on the basis of the assumptions and criteria given in this manual. The additional cost of the strengthened frame and shear walls was estimated to be 1 to 3 percent of the general construction cost of these buildings.

Asphaltic concrete and soil cement tested as riprap substitutes at Bonny Reservoir



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Test embankment of asphaltic concrete (left) and soil cement (right), prepared by U. S. Bureau of Reclamation, may provide answer to search for suitable riprap substitutes. Cost of earthfill dams in Great Plains States is materially increased by lack of conventional borrow for riprap facing of upstream slopes.

Full-scale tests of asphaltic concrete and soil cement as substitute materials for riprap on earth dams, on an experimental earth embankment at Bonny Reservoir in eastern Colorado, may give the answer to the problem of reducing the cost of constructing earth dams. The prototype testing program, following a period of intensive laboratory studies, is designed to evaluate the durability of asphaltic concrete and soil cement in lieu of conventional rock facings, for slope protection under a variety of severe service conditions.

Protection of the upstream slopes of earth dams has long presented problems when suitable materials for riprap were not locally available. The proposed construction of a large number of earth dams in the Great Plains States of Kansas, Nebraska, and the Dakotas by the Bureau of Reclamation has focused attention on this phase of dam building. Riprap for many of the proposed dams must come from the Rocky Mountains or from other areas far from the dam sites. Rail hauls or combination rail and truck hauls up to 200 miles or more are occasionally necessary if rock riprap is used. On some dams, it is estimated that the total cost of riprap may exceed $11 a square yard. The need for an economical substitute for this expensive riprap has been recognized by engineers, and much effort has been expended to develop satisfactory substitutes.

Several years ago the Bureau of Reclamation initiated a program to investigate riprap substitutes. The investigations covered suitable binding and cementing materials and the making and testing of numerous mixtures to determine their resistance to erosion and weathering, freezing and thawing, saturation and other factors. The possible benefits to be derived from use of the two common cementing materials, portland cement and asphalt cement, as binding agents for fine-medium and fine gravels, were apparent early in the investigations.

Effect of Waves Tested

The tests on asphaltic mixtures, in addition to conventional stability and immersion tests, included prolonged tests in a Bureau-designed wave-action machine which subjected specimens to rapid immersion and retraction from water, inducing high air and hydrostatic pressures on the surfaces of the specimens. At 40 cycles per minute some mixtures successfully withstood more than 2,500 hours of continuous testing.

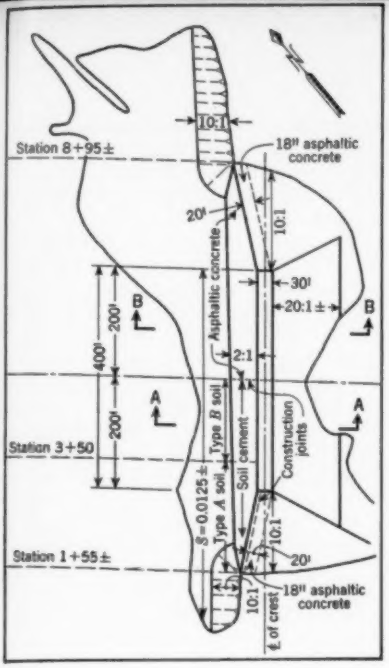
Investigation of soil-cement mixtures followed conventional test procedures of freezing and thawing, wetting and drying, resistance to abrasion, and weathering. Tests conducted on specimens of the selected soil-cement mixtures in the wave-action machine indicated high resistance to these destructive forces.

Although valuable information was obtained from these laboratory investigations, the data could be used only for basic designs of mixtures; adequate information could not be obtained on the behavior of facings of such material placed on slopes and subjected to the full impact of field conditions. To obtain this information on both soil-cement and asphaltic concrete facings, the Bureau last spring constructed a test embankment in the reservoir area of the recently completed Bonny Dam in eastern Colorado. The dam is located on the South Fork of the Republican River about 25 miles west of St. Francis, Kans., and a similar distance north of Burlington, Colo.

Construction of the test embankment and experimental facings was begun March 12, 1951, under an $82,900 contract awarded to the Northwestern Engineering Co. of Denver, Colo., which placed the asphaltic concrete facing. The earthwork and soil-cement facing were constructed by Baker & Burgwin of Denver, a subcontractor.

The test embankment was placed approximately two-thirds of a mile upstream from the south end of Bonny Dam and was positioned to face northwest, the direction of prevailing winds during late fall and winter storms. At expected normal water levels, the facings will be submerged to approximately two-thirds of their height. The wind fetch from the northwest will be about two miles, thus assuring appreciable wave development over the facings. In addition, the area is subjected to low winter temperatures which will produce freezing sprays and ice, and other severe conditions.

The test embankment has a total length of 740 ft, a crest length of 400 ft, and a maximum height of 26 ft.



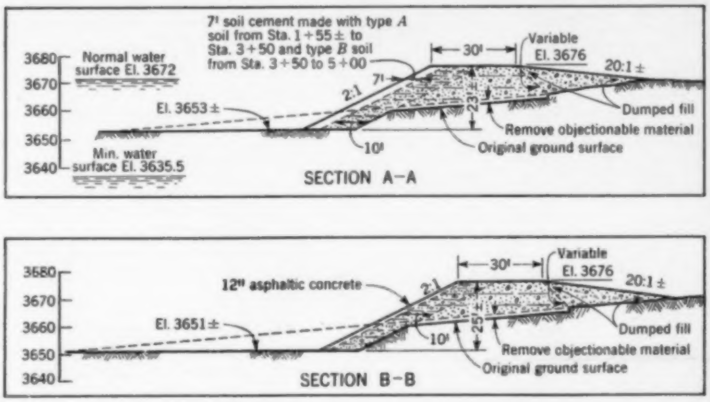


FIG. 1. Test embankment is located two-thirds of a mile upstream from Bonny Dam, Colorado. It faces northwest, where fetch of prevailing winds is about 2 miles. Area is subjected to low winter temperatures and should provide severe test conditions.

The slope of the embankment is 2:1, and the slopes of the ends, 10:1 (Fig. 1). The outer 10 ft of the embankment was constructed of compacted impervious material (fine silty sand) similar to the impervious material in Bonny Dam. The remaining embankment consists of compacted pervious soil and random dumped fill. A total of 28,300 cu yd of earth, obtained from adjacent borrow pits, was required in constructing the fill.

Half the face of the upstream slope was surfaced with a 3-ft thickness (measured normal to the slope) of soil cement. The remaining area was surfaced with asphaltic concrete varying from 6 to 18 in. in thickness.

Two types of soil were used to construct the soil-cement facings. A silty fine sand, designated as Type A, was placed at the southwest end of the embankment; and a poorly graded, medium-fine sand, designated as Type B, was used in the remaining area to the center of the test embankment. For stabilization, 12 percent by volume of portland cement was used in the mix containing Type A material, and 10 percent in the mix containing Type B material. Type B material was found to be somewhat easier to mix and place than Type A. Both soils were obtained from adjacent borrow areas.

The soils were dumped from trucks or scrapers and then spread by a dozer or motor patrol to a 7-ft width and an 8-in. depth. Cement was handled in sacks spaced accurately over the surface and then ripped open with shovels. A spike-toothed harrow, drawn by a small pickup truck, assisted in distributing the cement over the surface. Primary mixing of the dry soil and cement was accomplished by first scarifying the soil and cement to the full depth of the layer, using a scarifier attachment on a motor patrol, and then by pulverizing it by four to six passes of a 6-ft pulverizing mixer pulled by a crawler tractor.

After dry mixing, which resulted in complete dispersion of the cement throughout the soil, water was added through a gravity-feed spray bar suspended from a 1,600-gal tank truck. The pulverizing mixer was operated directly behind the water truck, and the wet mixing was completed with four to six passes. Sufficient water was then added to bring the soil-cement mix to optimum moisture for sheepsfoot compaction of the bottom two-thirds of the layer. Next, the surface was shaped by a motor patrol, and compaction of the top third of the layer was completed by rubber-tired rollers. Densities within 5 lb per cu ft of that obtained by the standard laboratory compaction test for maximum density were obtained throughout.

After compaction was completed, the surface was lightly scarified to insure bond to the succeeding layer, and the next lift of soil was placed immediately. Forty-six layers, approximately 6 in. thick, were placed. The soil-cement on the surface of the slope was cured for the required 7-day period by blading additional soil from the working lift over the completed lift. In this way, all soil cement was kept covered until the end of the curing period. The face of the soil-cement section was cut to a 2:1 slope by a motor patrol at the end of the shift on alternate days.

Asphaltic Concrete Placed

Asphaltic concrete was placed in thicknesses of 18, 15, 12, 9, and 6 in., each thickness being placed on the slope in a lane 40 ft wide. The 18-in. thickness was placed adjacent to the soil-cement sections. In addition to the 40-ft lanes, asphaltic concrete was placed on the 10:1 slopes at the ends of the embankment to prevent erosion behind the facings.

Sand and gravel aggregates for the asphaltic concrete were obtained from pits near the dam site. Grading of the aggregate in the mix corresponded closely to the original analysis of the pit-run material. The aggregate was screened and proportioned in a continuous-flow plant after drying and heating. The average grading of the aggregate in the mix was as follows:

Sieve Size	Percentage Passing
1 in.	100
No. 4	93
No. 10	76
No. 40	34
No. 200	3

The asphaltic material was shipped by truck from a refinery near Garden City, Kans., and consisted of a 40–50 penetration, steam-refined asphalt cement, proportioned at from 7 to 8 percent of the dry weight of the aggregate. A 300-deg F temperature was maintained in the mix leaving the plant.

Spike-toothed harrow (top) pulled by small pickup truck, distributes cement, previously dumped from bags by hand, along lane of soil-cement section of test embankment. Pulverizing mixer (middle view) completes primary mixing of dry soil in from four to six passes. Immediately above, surface of soil-cement section is shaped by grader. Compaction of top third of surface was by rubber-tired roller. Curing of slope surface was accomplished by blading soil from working lift over completed lift.

The mixing plant, which included a dryer and continuous mixer, had a rated capacity of 120 tons per hour, but attained an average rate of only about 15 tons per hour during the construction period because of delays in placing, weather, and other factors. The plant was set up about 300 ft from the test embankment.

Ideally, asphaltic facings should be constructed in a single lift, avoiding the possibility of separation of the layers under the action of water. However, on the Bonny 'test embankment, equipment necessary to accomplish this method of placement was not available, and a conventional finishing machine and an 8-ton tandem roller were initially used. The finishing machine proved impractical on the 2:1 slopes because of the inability of the finisher to control the thickness of the placed material. Therefore the major part of the asphaltic facing was constructed by a slip-form which placed lifts of from 2 to 4 in. Placement in thin lifts was necessary because thick lifts cracked badly when rolled completely cold, and satisfactory densities could not be obtained. By starting the rolling of thin lifts at a surface temperature of about 150 deg F, densities exceeding the required 90 percent (based on laboratory-compacted material) could be obtained.

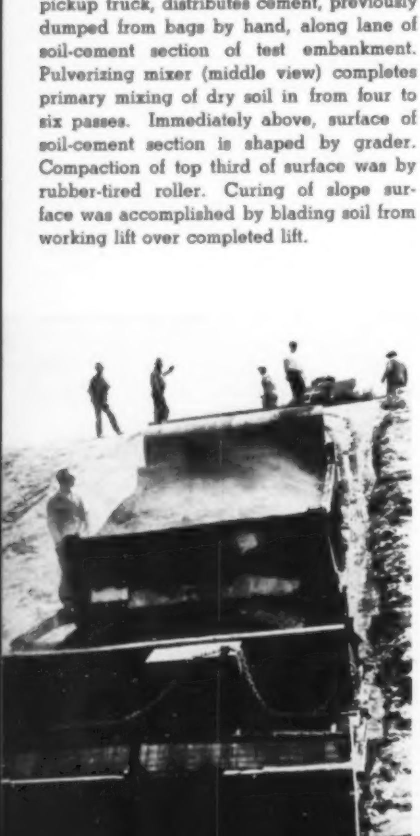
The asphaltic mix was spread up the slope, starting at the bottom, by spreader box. Trucks were lowered to the spreader box on the slope by cables from a tractor. Each lift was placed in a lane 10 ft wide. The joints and surface of each lift were cleaned and tacked by a light application of rapid-curing, cutback asphalt preparatory to placing the next lift.

All work on the experimental facings was completed by May 28, 1951, and water covered the facings to a depth of approximately 5 ft by June 20. In so far as weather and precipitation conditions permit, water will be maintained at approximately one-half to two-thirds the height of the facings during the life of the test section.

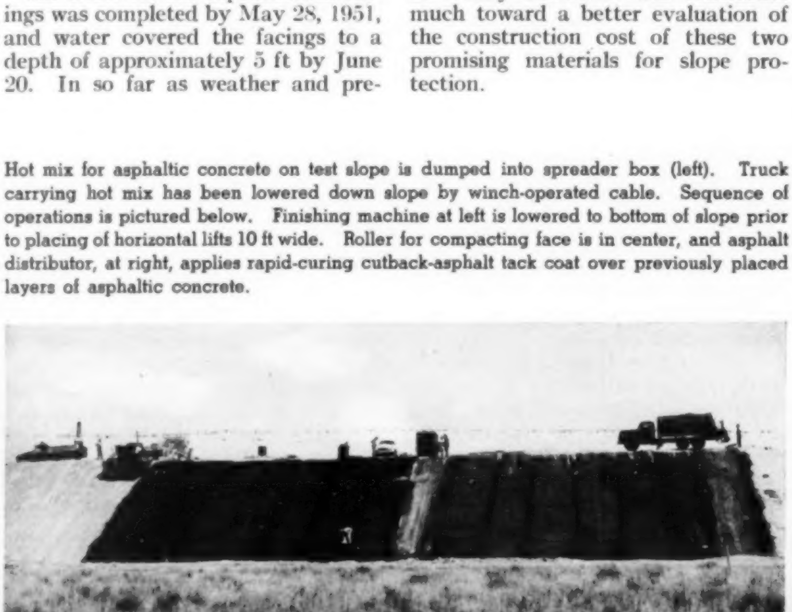
The cost of the soil-cement facing, based on bid prices, including the cost of all materials, was approximately $9 a sq yd for a 3-ft normal thickness. Efficient use of equipment, which included placing of the earth embankment concurrently with placing and mixing of the soil cement, placing in horizontal lifts 10 ft wide, and the use of a uniform thickness of facing, made possible low costs for this part of the work. The subcontractor for the soil-cement construction stated that the cost of this type of work could be appreciably reduced on a large-scale installation.

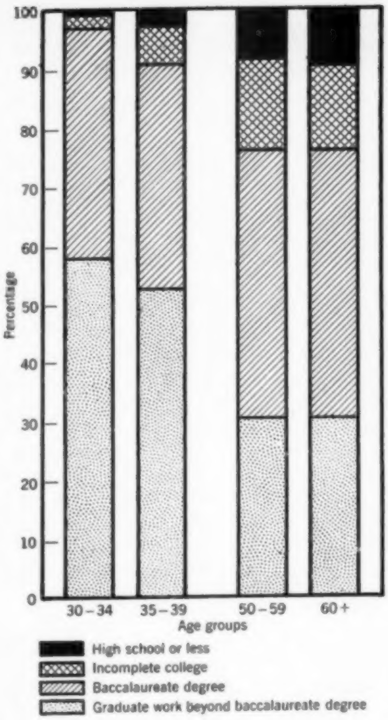
The cost of the asphaltic concrete, also based on bid prices and including the cost of all materials, was approximately $16 per sq yd, based on a 1-ft thickness, the thickness tentatively indicated as desirable for slope protection. The high bid prices for the asphaltic concrete were due largely to the rental and move-in costs of special equipment, such as the mixing plant and dryer, finishing machines and rollers prorated among small items of construction. The unit cost for the asphalt work would undoubtedly be much lower on a large-scale installation, and the unit prices bid on this phase of the work have little value for purposes of determining comparative costs.

At this time, the relative merits of the two materials are being considered primarily on the basis of their behavior during prolonged periods of service rather than of indicated construction costs. However, the installation of the experimental facings at Bonny Reservoir will contribute much toward a better evaluation of the construction cost of these two promising materials for slope protection.



Hot mix for asphaltic concrete on test slope is dumped into spreader box (left). Truck carrying hot mix has been lowered down slope by winch-operated cable. Sequence of operations is pictured below. Finishing machine at left is lowered to bottom of slope prior to placing of horizontal lifts 10 ft wide. Roller for compacting face is in center, and asphalt distributor, at right, applies rapid-curing cutback-asphalt tack coat over previously placed layers of asphaltic concrete.





Sanitary engineers tallied by APHA as national resource

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FIG. 1. Educational background of sanitary engineers in four age groups, 1949–1950, indicates increased amount of higher education in younger groups.

How many sanitary or public health engineers are there in the United States? The Health Resources Division of the National Security Resources Board in the late 1940's recognized the need for an accurate inventory of various professional specialties important to the maintenance of public health. The tally of physicians, nurses and dentists was relatively easy since the rosters of their national societies and the state registration tests contained most of those qualified. As for engineers, the American Public Health Association, through the Engineering Section Project, agreed to assemble data on those qualified to participate in public health activities. The project extended from the early spring of 1949 to October 1950.

The first major problem that arose was the definition to be adopted for a sanitary engineer. If a broad definition were adopted a truly staggering number of engineers would qualify. The definition selected was that approved by the Committee of Sanitary Engineering of the National Research Council in October 1943. This definition states:

The professional occupational title "Sanitary Engineer" shall apply to a graduate of a full 4-year, or longer, course leading to a bachelor's, or higher degree* at a college or university of recognized standing** with major study in engineering, who has fitted himself by suitable specialized training, study, and experience (*a*) to conceive, design, direct, and manage engineering works and projects developed, as a whole, or in part, for the protection and promotion of the public health, and (*b*) to investigate and correct engineering works and projects that are capable of injury to the public health by being or becoming faulty in conception, design, direction or management. The practice of sanitary engineering includes the following activities:

(*a*) Surveys, reports, designs, direction, management and investigation of:

(1) Waterworks or sewerage systems and closely related engineering structures.

(2) Projects relating to stream pollution, insect and vermin control or eradication, rural and camp sanitation, housing sanitation, and milk and food sanitation.

(3) Systems for the prevention of atmospheric pollution or the control of indoor air, especially the air of working spaces in industrial establishments (industrial hygiene engineering).

(*b*) Professional research and laboratory work supporting the activities listed in (*a*).

(*c*) Responsible teaching of sanitary engineering and closely related subjects in colleges or universities of recognized standing.

* Persons lacking in formal education but who otherwise meet the terms of the above definition may be considered as having the equivalent of a full four-year course in engineering in a college or university of recognized standing provided they have sufficient experience or training of the type defined above to substitute for the engineering education lacking. The basis of such substitution shall be two years of appropriate training or experience equivalent to one year of formal engineering education, and such persons shall be considered professional sanitary engineers for the purpose of the Roster.

** A college or university of recognized standing is defined as one which is accredited by a national or regional accrediting association such as the Association of American Universities, or the New England, Middle States, North Central, Southern, or Northwest Association of Secondary and Highe Schools, or one whose professional curriculum ha been accredited by the Engineers' Council for Pro fessional Development or the Committee on Pro fessional Education, American Public Healtl Association.

Preparation of a preliminary mailing list was difficult because no single source of information was available. A start was made by combining the membership of the Engineering Section of the American Public Health Association; the Sanitary Engineering Division of ASCE; the old file prepared by the War Manpower Commission; engineers commissioned in the Sanitary Corps of the Army; and selections from the membership lists of the American Water Works Association and the Federation of Sewage Works Associations. In addition, state sanitary engineers, acting on the recommendation of the Conference of State Sanitary Engineers, submitted the names of all engineers in their states known to be trained in sanitary engineering. Several large consulting engineering firms provided the names of sanitary engineers on their staffs. The rosters of state engineering registration boards were reviewed, although only 27 state rosters (in 1949) indicated engineering specialization, and of these only 17 designated a specialty of sanitary engineering. Publicity

in various engineering journals helped to bring in the names of engineers not otherwise reached.

A self-coding type of questionnaire was prepared for use in collecting information. Funds available did not allow for professional review of returned questionnaires. The information submitted was transferred directly onto business machine cards except for the correction of obvious errors that could be recognized by good clerical personnel.

Of the almost 11,000 questionnaires mailed, the following accounting can be made:

Total mailed	10,757
Returned, sanitary engineers	4,933
Returned, not sanitary engineers	1,240
Deceased	179
Returned by post office, address unknown	627

Since it was desirable to obtain some estimate of the number of non-engineers who had replied affirmatively to the leading question, "Do you qualify as a sanitary engineer?" a spot check was made of returned questionnaires. Statements of qualifications could not be verified easily but it was possible to determine a probable maximum number of non-engineers. A total of 243 questionnaires were selected at random and reviewed for collateral evidence of engineering qualifications. Substantiating qualifications included:

Registration with any state board of engineering registration.

Graduation from college with a degree in engineering.

Membership in a professional society for which professional status is a prerequisite for membership. There were two organizations that provided helpful criteria—the American Society of Civil Engineers in a Member or Associate Member grade and the National Society of Professional Engineers.

Of the 243 selected, 238 were found to have good evidence of professional engineering qualifications. Only 5, or 2.25 percent, could not be verified as having engineering qualifications on the basis of information submitted in the questionnaires.

The survey figures indicate that for the continental United States the average is 3.2 sanitary engineers per 100,000 population. The states range from a low of 1.4 engineers per 100,000 in Kentucky to a high of 7.7 in the District of Columbia. It is interesting to note that Alaska has a ratio of 5.4 and Puerto Rico 0.5 engineers per 100,000. (See Table I.)

Ways in which sanitary engineers practice their talents are shown in Table II. Public health agencies rank highest with 1,365, almost 28 percent of the total. Practically all of this group, 1,286 out of 1,365, are actually engaged in engineering, with state agencies employing 651; municipal agencies, 290; federal agencies, 263; and special districts, 82. Executive duties were listed by 58 as the type of work performed. Consulting offices employed the next largest number with 1,239, or 25 percent. Various public works agencies employ another 18 percent.

Less than 15 percent of the engineers reported that they were not practicing sanitary engineering. On the other hand, more than 50 percent were giving more than 75 percent of their time to sanitary engineering duties. A total of 16 percent devote half to three-quarters of their time to sanitary engineering; and just under 17 percent devoted some, but less than 50 percent, of their time to sanitary engineering activities. (See Table III.) It is interesting to note that of the total of 4,933 sanitary engineers, 9 are women.

Professional Qualifications Studied

The professional qualifications of sanitary engineers are of particular importance to many groups. One of the cardinal objectives of the American Public Health Association has been the improvement of the professional status and training of all public health specialties. Our studies record the professional qualifications of sanitary engineers in two ways: first by the extent of education; and second, by the extent of registration as professional engineers.

The greatest number, by age distribution, falls in the age groups 35–39 and 40–44, each group having 16 percent of the total (Table IV). There were only 115 individuals younger than 25 years but 622 older than 60.

Sixteen years of education, considered in the study as equivalent to a baccalaureate degree, is the extent of education of 43 percent of the engineers. On the other hand, 18 percent have had eighteen or more years of education. Only 4.5 percent had 12 years, an equivalent to graduation from high school, or less of education, and of these, 180 or 79 percent were 45 years old or more.

There is evidence of differing educational backgrounds in different age groups. If the age groups 30–34 and 35–39 are compared with the 50–59 and 60-and-over groups, a sharp difference can be noted. In the younger groups, 39 and 38 percent, respectively, had 16 years of

TABLE I. Distribution of Sanitary Engineers by States, 1949–1950

State	% per 100,000 Pop.	State	% per 10,000 Pop.
Ala.	2.7	N.J.	4.0
Ariz.	2.4	N. Mex.	2.2
Ark.	2.0	N.Y.	3.3
Calif.	3.7	N.C.	2.0
Colo.	3.8	N. Dak.	3.4
Conn.	4.2	Ohio	3.2
Del.	2.2	Okla.	3.5
D.C.	7.7	Oreg.	5.5
Fla.	3.5	Pa.	2.6
Ga.	3.2	R.I.	2.8
Idaho	5.6	S.C.	2.2
Ill.	3.7	S. Dak.	3.5
Ind.	3.5	Tenn.	2.9
Iowa	4.3	Tex.	3.1
Kans.	2.8	Utah	3.5
Ky.	1.4	Vt.	2.4
La.	1.8	Va.	3.5
Me.	2.2	Wash.	4.7
Md.	5.7	West Va.	1.8
Mass.	3.7	Wis.	3.2
Mich.	2.8	Wyo.	1.7
Minn.	3.2	Continental	
Miss.	1.6	U.S.	3.2
Mo.	3.6	Alaska	5.4
Mont.	3.2	Hawaii	4.0
Neb.	2.3	P.R.	0.5
Nev.	5.0		
N.H.	3.8	Total U.S.	3.2

TABLE II. Distribution of Sanitary Engineers, by Major Type of Employment, 1949–1950

Type of Employment	Sanitary Engineers No.	Sanitary Engineers %
Public health agencies:		
Engineering:		
Federal agencies	263	5.3
State agencies	651	13.2
Municipal agencies	290	5.9
Special districts	82	1.7
Executive	58	1.2
Other	21	0.4
Total	1,365	27.7
Public works agencies	868	17.6
Utility companies	225	4.6
Consulting offices	1,239	25.1
Industrial organizations	386	7.8
Academic institutions	265	5.4
Special agencies*	119	2.4
Public administration	177	3.6
Otherwise classified	264	5.4
Information not given	25	0.4
Total	4,933	100.0

* Includes professional societies, non-government agencies and military services.

TABLE III. Distribution of Proportion of Time Devoted to Sanitary Engineering, 1949–1950

	Sanitary Engineers No.	Sanitary Engineers %
Practicing sanitary eng.:		
Over 75% of the time	2,586	52.5
50.0 to 75.0% of the time	795	16.1
Less than 50% of the time	823	16.7
Total	4,204	85.3
Not practicing sanitary eng.	726	14.7
Information not available	3	. .
Total	4,933	100.0

TABLE IV. Age Distribution by Total Years of Education of Sanitary Engineers, 1949–1950

Age Group	Total Years of Education*										
	Under 12	12	13	14	15	16	17	18	Over 18	No record	Total
Under 20 years	..	..	..	..	..	2	..	..	..	..	2
20–24	..	1	..	2	1	75	21	10	3	..	113
25–29	..	..	1	..	2	242	178	49	32	1	505
30–34	..	2	6	10	4	241	207	94	58	..	622
35–39	2	18	7	15	28	300	242	105	72	..	789
40–44	6	20	14	30	33	318	212	90	61	1	785
45–49	13	36	11	29	47	290	140	48	47	..	661
50–59	24	46	28	42	58	378	146	52	60	..	834
60 years and over	22	39	23	33	32	278	77	52	59	7	622
Total	67	162	90	161	205	2,124	1,223	500	392	9	4,933

* High school graduation was considered to be equivalent to 12 years, and graduation from college with a baccalaureate degree as 16 years of education.

education, whereas in the older groups 45 percent had 16 years. But 58 and 53 percent of the younger groups had graduate work beyond the baccalaureate degree as contrasted with 31 and 30 percent in the older groups. On the other end of the scale only 0.3 and 2.5 percent in the younger groups had a high school education or less as contrasted with the 8 and 10 percent in the older groups. There is a definite shift in the younger age groups toward more extensive education.

The extent of registration among sanitary engineers is shown in Table V. A total of 3,413, or 69 percent, were registered, a ratio of registered to non-registered of 2 to 1. The percentage registered varied in the principal types of employment from a high of 87 percent among those employed by consulting organizations, to a low of 53 percent among those employed by special agencies. Employees of public health agencies and industrial concerns reported 59 percent registered, next to the lowest in the eight specific categories listed. It will be noted that employees of state and municipal agencies had the highest rate of registration, 62 and 63 percent respectively, in public health agencies.

Approximately one-third, or 1,681, at the time of the study, had reserve commissions or were on active duty with one of the defense departments or the U. S. Public Health Service (Table VI). Half of these were with the Army. Public Health Service commissions were held by 321, of which 134 were regular officers and the remainder in a reserve capacity. Slightly over 11 percent, 188 in all, were in the regular service of one of the military departments or the U. S. Public Health Service.

On the average, engineers reported membership in two professional or technical societies. The complete list is as follows:

American Industrial Hygiene Association	124
American Institute of Chemical Engineers	65
American Public Health Association	828
American Public Works Association	268
American Society of Civil Engineers	2,265
American Society of Mechanical Engineers	78
American Water Works Association	1,658
Conference of Municipal Public Health Engineers	122
Conference of State Sanitary Engineers	187
Federation of Sewage Works Associations	1,765
National Malaria Society	82
National Society of Professional Engineers	1,065
Other	1,980

(This article is based on the paper presented by Mr. Elder before the Manpower Session of the Engineering Section, October 31, 1951, at the 79th Annual Meeting of the American Public Health Association.)

TABLE V. Registration of Sanitary Engineers by Principal Type of Employment, 1949–1950

Type of Employment	Sanitary Engineers		
		Registered	
	Total	No.	%
Public health agencies:			
Engineering:			
Federal	263	127	48.3
State	651	405	62.2
Municipal	290	182	62.8
Special district	82	44	53.7
Executive	58	33	56.9
Other	21	9	42.9
Total	1,365	800	58.6
Public works agencies	868	611	70.4
Utility companies	225	145	64.4
Consulting offices	1,239	1,072	86.5
Industrial organizations	386	226	58.5
Academic institutions	265	167	63.0
Special agencies*	119	63	52.9
Public administration	177	138	78.0
Otherwise classified	264	178	67.4
Information not given	22	13	59.1
Total	4,933	3,413	69.1

* Includes professional societies, non-governmental agencies and military services.

TABLE VI. Sanitary Engineers Holding Commissions in the Military Services and the U. S. Public Health Service, 1949–1950

Branch or Arm	Regular Active Duty	Reserve Status		Inf. Not Available	Total
		Active	Inactive		
Affiliated:					
U.S. Army	27	503	259	27	816
U.S. Navy	11	89	265	6	371
U.S. Air Force	10	42	60	5	117
U.S. Public Health Service	134	52	124	11	321
National Guard	5	13	5	..	23
Other	1	9	12	11	33
Total	188	708	725	60	1,681
No affiliation	..	..	..	..	3,239
No information available	..	..	..	..	13
Total	..	..	..	..	4,933

Iowa's

WALTER H. ROOT, M. ASCE

Maintenance Engineer, Iowa State Highway Commission, Ames, Iowa

Under a newly adopted stop-gap resurfacing program, the Iowa State Highway Commission in 1952 will complete temporary repairs on 500 of the 1,000 miles of primary highways classified as deficient following the spring breakup of 1951. At the rate the state had been resurfacing such roads under its all-out reconstruction program, it would have taken 22 years to rehabilitate these 1,000 miles. Since steadily increasing traffic loads would render such a delay disastrous, Iowa initiated a temporary resurfacing program of a sort that could be utilized to ease similar situations in other states. Some stop-gap resurfacing program, if not that adopted by the State of Iowa, is necessary if highway transportation in the United States is not to be seriously handicapped or, as many would argue, to break down entirely.

As a layman, as a user of the highways, and as a reader of the current press—both technical and non-technical—I find it obvious that the United States is about to begin the most extensive road-building program in its history. There can be no disputing the fact that for the past ten years road building has not kept pace with road use.

The question of the actual extent of the highway deficiencies is, of course, debatable. T. H. MacDonald, Hon. M. ASCE, Commissioner of the Bureau of Public Roads, reported at the October 1951 meeting of the American Association of State Highway Officials in Omaha, that the accumulated deficiencies in the primary road system of the United States now total 75,000 miles, and are increasing by some 5,000 to 6,000 miles a year.

As a further case in point, Ralph A. Moyer, A. M. ASCE, in the Chairman's address at the January 1952 meeting of the Highway Research Board in Washington, stated that the California Division of Highways recently reported that 81 percent—11,300 out of 14,000 miles—of California's state highways show deficiencies of one kind or another. The California Division of Highways reported deficiencies totaling $440,000,000 in 1941, and five years later, in 1946, the deficiencies came to $1,700,000,000. A later report indicates that 1951 deficiencies amounted to slightly more than $3 billion, or eight times the 1941 deficiencies, allowing for construction expenditures of $500,000,000 since 1941. During the past three years California has expended $94,000,000 per year on construction of state highways. At this rate it will require 30 years to overcome the 1951 deficiencies. About 100 years would be required to complete the job of eliminating existing deficiencies on the 37,000-mile Interstate System at the present rate of construction.

In the meantime, however, motor vehicles cannot travel on plans and programs no matter how complete or adequate they may be. Time is an important factor that must not be overlooked in the problem. It takes time to plan overall needs for reconstruction, to arrange financing in an adequate way, to prepare detailed plans for even the first group of projects in a comprehensive plan. It takes time to award contracts, to secure necessary right-of-way, and to complete the construction work. States anxious to sidestep these time-consuming details will be interested in the program inaugurated by the Iowa State Highway Commission.

Critical Situation Arises

In 1951 the State of Iowa had experienced the worst winter and spring in fifteen years. This was the straw that broke the camel's back. The Highway Commission decided that its Maintenance Department simply did not have the funds and the facilities to put disintegrating pavements in satisfactory shape for travel.

At this time Iowa had in its primary road system 5,725 miles of high-type pavement, practically all of which was concrete. Of this mileage nearly 500 miles were over 25 years old and 2,670 miles were between 20 and 25 years old, a total of 3,170 miles, or about 55 percent of the road system. Most of these old pavements were built in the late 1920's and early 1930's, at which time the average traffic was about 500 vehicles per day. Present figures indicate that the average traffic per main artery is 1,200 vehicles a day.

In addition, we were not building as good pavements 20 or 25 years ago as we are today. We have learned for instance that some aggregates which, from a laboratory standpoint, appear satisfactory are not adequate when placed in a pavement exposed to traffic conditions. Such aggregates, used in a limited mileage of early pavements, are excluded by present specifications.

stop-gap resurfacing program speeds highway improvement

Following spring breakup of 1951, 1,000 miles of Iowa highway was estimated to be in deteriorating condition. By patching old surface with applications of two 1½-in. courses of hot-mix bituminous material (photos, left), 500 miles of deficient paving will be reconditioned at cost of about $15,000 per mile by end of 1952, saving money and eliminating delay of 15 to 22 years required for complete modernization program.

The disintegration of Iowa roads is not a new problem. In the early 1940's it was evident that a considerable mileage of the primary road system should be widened and resurfaced in order to salvage existing highways and to provide a more satisfactory road for the traveling public. However, the war and subsequent shortages delayed the improvement program until 1948. In that year 22.6 miles of highways were built at a cost of $1,200,000, 70.8 miles were built at a cost of $4,000,000 in 1949, and 40.9 miles were built at a cost of $2,400,000 in 1950. The 1951 program called for 31.5 additional miles of paving estimated to cost $3,125,000.

This widening and resurfacing done from 1948 to 1951 was of a very high type. Where sight distances were too short and where curvature was unsatisfactory, the old pavement was entirely removed, the necessary grading done, and new sections of pavement constructed. Where the old pavement was on a satisfactory grade and alignment, it was thoroughly patched either with portland cement concrete or bituminous concrete before resurfacing was undertaken. Most of the pavements were widened from 18 to 24 ft and the roadside was completely rebuilt. This required the purchase of additional right-of-way and the movement of large quantities of earth to produce shoulders of standard width and slopes of standard flat sections. The project also included the lengthening of culverts to accommodate the wider fills, and in most cases the widening of bridges.

Some of the resurfacing was of portland cement concrete with a minimum thickness of 6 in., and some was of hot-mix bituminous concrete in two 1½-in. courses. The average cost per mile of pavement improvement from 1948 to 1951, regardless of type of resurfacing, was as follows:

Right-of-way	$ 3,041
Bridges and culverts	10,609
Grading	11,899
Widening and resurfacing	44,422
Detours	1,233
Miscellaneous	851
Total	$72,055

Excluding cost expenditures for right-of-way, bridges and culverts, grading and detours, the resurfacing costs for 115.7 miles of bituminous concrete pavement were $4,300,000, or about $37,000 per mile. Portland cement concrete was utilized for 39.4 miles of roads at a totol cost of $2,050,000, or approximately $52,000 per mile.

The entire three-year program produced a total of 134.3 improved miles. However, this improved mileage, contrasted with the 1,000 miles of primary paving in precarious condition following the spring breakup of 1951, demonstrated the necessity of an immediate stop-gap salvaging program for Iowa roads. Traffic could not wait the 22 years required for rehabilitation at the previous rate of construction, or the 15 years required at a considerably accelerated rate.

The Highway Commission decided to resurface the entire 1,000 miles of damaged concrete with 3 in. of hot-mix bituminous concrete as fast as contracts could be let. This stop-gap resurfacing did not include any widening, grade reduction, or alignment changes. It consisted merely of patching the old surface and applying two 1½-in. courses of hot-mix bituminous material. On much of the mileage to be resurfaced there was a sloping curb section 3 in. high, and such sections were simply filled in between the curbs, the drainage being carried in shallow auxiliary side ditches.

The program required no surveys in the usual sense and very little in the way of plans. During the summer, 541.6 miles of this type of surfacing were placed under contract, and 130 miles were completed before the work had to be shut down for the winter. Difficulty in getting contractors to undertake the program was expected but there was satisfactory competition on every job. In some areas the material producers were loaded up to the extent that activities had to be shifted to other sections where materials were more readily available. The Highway Commission expects to complete about 500 miles of this type of improvement in 1952.

Although stop-gap resurfacing is relatively cheap, it does produce a smooth, satisfactory surface in a minimum period of time. Average costs per mile in 1951, totaling $15,290 per mile, were: patching, $1,137; bituminous concrete, $13,728; and shoulders, $425.

It should be kept in mind that the Iowa State Highway Commission does not consider these roads finished products. It is intended that much of the stop-gap surfacing will later be fitted into a complete rebuilding program. Completion of the surfacing of the 1,000 miles of critical pavement is expected by the end of 1953, thus producing a good usable surface in three years and eliminating the delay of 15 to 22 years that would be required for a complete modernization program.

Men, machines and money bring out Labrador iron ore

Three towns, two hydro developments, and a 365-mile railroad are among features of mammoth construction project

F. C. WARDWELL, M. ASCE, General Superintendent, Stone & Webster Engineering Corp., Mont Joli, Quebec, Canada

Reaching some 300 miles north of the St. Lawrence River, the steel industry is now preparing to tap the deposits of iron ore along the northern Quebec-Labrador boundary. Although their existence has been known for many years, these Labrador deposits have attracted serious attention only recently with the dwindling of Upper Superior ore reserves and the increasing demands for steel. While this field is not too far distant from the United States, its remoteness from accessible transportation and the climatic conditions affecting its development have directed considerable attention to it during the past two years. It is about midway between Hudson Bay and the Atlantic Ocean and its center lies some 300 miles north of the St. Lawrence Gulf.

Ore deposits occur in a geosyncline, referred to as the Labrador trough. This trough is about 400 miles long and varies in width up to 60 miles. It extends in a northwesterly direction nearly to Ungava Bay. Only in certain places is the iron sufficiently concentrated to be commercially useful.

The presence of iron in this district was known as far back as 1894 when reference to it was made in the reports of the Canadian Geological Survey. At later dates prospectors searching for other metals also reported iron formations in the district. It was not until recently, however, with the dwindling of supplies of Lake Superior ore, that the working of deposits in this remote area was considered commercially feasible.

From 1942 to date extensive prospecting has been in progress. In 1947 an air strip was built near Knob Lake. This speeded up the work on the Labrador lode by increasing the amount of equipment, supplies and personnel that could be brought in during the short summer working season of about five months. By the fall of 1950, a total of 417 million tons of high-grade ore had been proved up and development expenditures had risen to over ten million dollars.

The productive zone developed to date is from 4 to 5 miles wide and some 90 miles long. The ore occurs as concentrated deposits in the iron formation. Iron content (dry) usually varies from 54 to 61 percent. A little over 10 percent of the proved ore contains manganese in a percentage sufficient to command a premium price as manganiferous iron ore. The ore usually occurs in low ridges, having little or no overburden, which permits open-pit mining operations.

By 1949 the great possibilities of the field had been realized, and early in the summer of that year plans for transportation of the ore were being formulated. Aerial photographs were used to determine the general location for the railroad but were not sufficiently accurate to fix the final location. Field locating parties were sent out in the spring of 1949, and by July 1950, sufficient information had been obtained to determine grades and curvature and to permit a reasonably accurate estimate of the cost of railway construction and other development work.

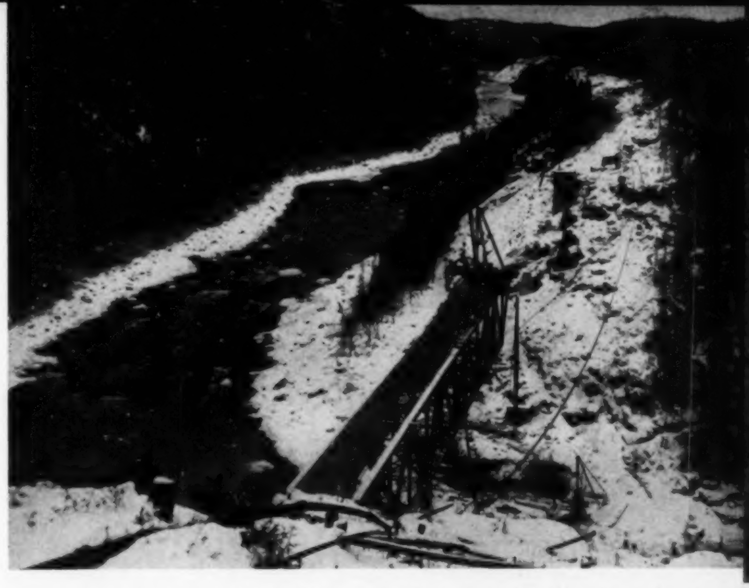
In 1949, the Iron Ore Company of Canada was formed for the purpose of financing the development and operation of the project. Five outstanding steel companies—Armco Steel Corp., National Steel Corp., Republic Steel Corp., Wheeling Steel Corp. and the Youngstown Sheet and Tube Co.—joined with Hollinger Consolidated Gold Mines Ltd., the M. A. Hanna Co., and the two existing concession companies (Labrador Mining & Exploration Co., Ltd., and Hollinger North Shore Exploration Co., Ltd.) in order to prepare for commercial production.

The project as a whole is made up of a number of units, any one of which would be considered a major construction job. Among the major units are the geological explorations and mapping, mine development, construction of the railroad, two hydroelectric developments with their transmission lines and substation, loading and storage facilities, three town sites, and many minor units.

The two mining concessions, embracing an area roughly 130 miles wide by 180 miles long, must be completely explored, mapped and prospected within a few years' time to determine what small areas are to be retained and what major areas relinquished. The season in which this work can be done is only about 5 months long and much of the area is difficult to reach.

The Menihek power site is about 30 miles south of the mining area. Here a combination concrete spillway and dam, flanked on each side by

FIG. I. Reaching far into desolate areas of Canada, industry is starting to make use of remote deposits of Labrador iron ore.



Largest structure along railway is Moisie River Bridge at Mile 12. Total length of bridge is 708 ft with maximum span of 248 ft. About 25 steel bridges will be erected along railway.

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To provide power for the terminal facilities at Seven Islands, a power plant is being constructed on the St. Marguerite River, some 20 miles west of Seven Islands. This plant, consisting of a concrete dam with short flanking earth dikes, will develop about 100 ft of head. Two 12,000-hp turbines will be initially installed. This project is being constructed jointly with the Gulf Pulp and Paper Company.

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The railway is the major unit of construction and, exclusive of rolling stock, makes up about one-third of the cost of the project. The southern terminal is at tidewater at Seven Islands, a 300-year-old fishing village on the north shore of the St. Lawrence Gulf, about 485 miles northeast of Montreal. The line extends in a northerly direction 362 miles to the northern terminal at Knob Lake, a five-year-old mining camp.

The line lies in the middle of a barren territory, a quarter of a million square miles in area, utterly devoid of population except for an occasional itinerant trapper and prospector. Late maps do not show the location of even a single village within 300 miles of Knob Lake. Even the Hudson Bay Co. abandoned its few trading posts in the area 75 years ago.

In July 1950, tenders were extended for the construction of the railroad, and on September 23, 1950, a contract was awarded to a combination of Canadian contractors. This combination is composed of Cartier Construction Co. Ltd., MacNamara Construction Co. Ltd., Fred Mannix and Co. Ltd., and Morrison-Knudson Co. of Canada, Ltd. For brevity this combination is generally referred to as C.M.M.K.

The contract provides that the owners, the Quebec North Shore and Labrador Railway Co., a subsidiary of the Iron Ore Company of Canada, will purchase all materials and equipment required for construction and deliver them to Seven Islands, and further will provide necessary air transportation for such materials and personnel. The C.M.M.K. will provide personnel and supervision and will perform the necessary grading, track laying and ballasting. For their work the contractors will be paid a fixed fee and will also participate in a percentage of any savings made in the overall estimated cost, or in any overruns in the estimate up to a certain percentage of the fee. The target estimate is based on the sum of the various estimated units, multiplied by an agreed unit price for each unit. When the final quantities become known, the target estimate (of about 26 million dollars) will be adjusted and then the fee to be paid the contractors will be computed. The same contractors were later awarded contracts for the construction of the two power stations and some other minor work, on much the same basis as the railroad work.

Railway Location

As it leaves Seven Islands, the railroad crosses the coastal plane for about ten miles until it reaches the first foothills. After passing through a tunnel, it crosses the Moisie River on a 708-ft bridge about 180 ft above the floor of the canyon. The line then follows the Moisie, Nipissis and Wacouno Rivers much of the way in steep and narrow gorges. In this area it rises from sea level to El. 300 in the first 55 miles, and to El. 1,600 in the next 41 miles. Much of the heavy grading and all of the curvature above 6 deg are in this area. The line then traverses rolling country, broken by steep ridges, until the summit at El. 2,056 is reached at Mile 149. Here the line enters Labrador and for the rest of the way traverses the Labrador Plateau at elevations varying from 1,550 to 2,056. A few miles from Knob Lake

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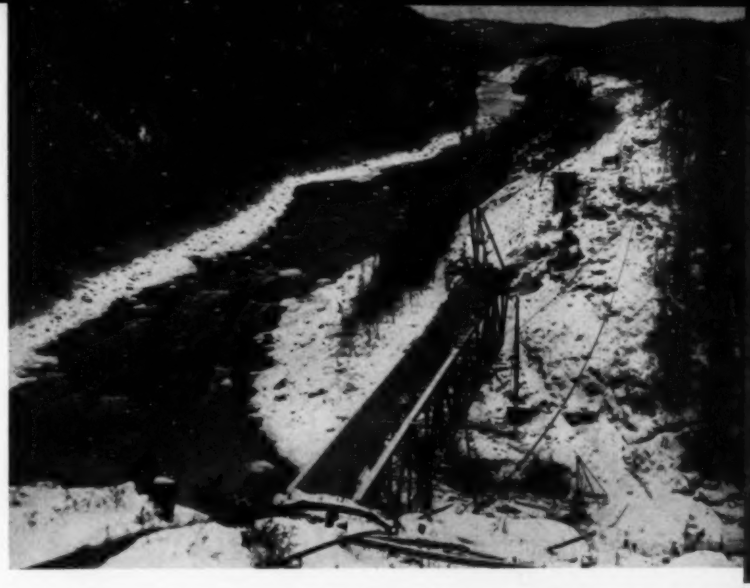

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Typical of rugged terrain traversed by railroad is this section of finished grade at Mile 22.

the line again crosses the divide at El. 1,665 and reenters the Province of Quebec.

After leaving the coastal plain at the south end, the line encounters much solid rock, with a few stretches of clay, gravel and sand. Beyond Mile 100 less solid rock is found. Gravel, intermixed with large boulders and occasionally clay, predominates. At the north end more rock and hardpan are encountered, including a small amount of low-grade iron formation. In the total quantity to be moved, common excavation will probably average around 60 percent. On the upper half of the line considerable amounts of shallow muskeg are present.

Single-Track Railroad Construction

The railroad as constructed will be a single-track line. The roadbed is 18 ft wide on fills and 26 ft wide in cuts. Alignment and grades presented some difficult problems on the south end through the river canyons, where it was necessary to go to curves as sharp as 8 deg maximum, although not many of these were necessary. Above Mile 93 curvature has been limited to a minimum of 6 deg. All curves are spiraled by superelevation.

Grades of about 1.3 percent against the inbound empties were necessary for a few miles between Miles 55 and 75. In the remainder of the line, grades under 0.9 percent were obtained except in a few minor instances. Grades against the outbound loads, over the entire line, have been limited to 0.4 percent, compensated for curvature.

Treated ties, a considerable part of which will be cut along the right-of-way and job treated, will be used on the entire main-line track. All ties will be tie plated.

Rail of 132 lb per yd will be laid on the main line, the first rail as heavy as this to be laid in Canada. An ample number of passing tracks will be provided, each with a capacity for a 100-car train.

Gravel ballast will be used exclusively. An ample supply of good ballast within a reasonable hauling distance is found at many places along the right-of-way.

Centralized train control will be provided by having all main-line switches electrically operated with automatic block signals at all points on the line.

About 25 steel bridges will be required, the longest being across the Moisie River. This bridge consists of three deck-truss spans respectively 135 ft, 248 ft, and 202 ft long, flanked by 3 deck-girder spans at one end. All the other bridges will be plate-girder spans from 60 to 100 ft long and varying from one to three spans in length. All bridges will rest on concrete foundations, usually bedded on rock. Occasionally pile foundations will be necessary to support the concrete.

About 81,000 lin ft of culverts are required. All will be of corrugated iron varying in size from 24 in. to 144 in. in diameter.

Two tunnels, one 2,250 ft long and the other 600 ft long, will be needed. These tunnels are through rock and will not require lining.

Terminal facilities will include storage yards and repair facilities at Knob Lake, a large yard totaling about 43 miles of track at Seven Islands, and a small yard at Midway.

It has been necessary to erect a large number of buildings for construction purposes. In general, such buildings have been so designed that they can be used later in railroad operation as section houses, tool houses, warehouses and other operating buildings.

Storage facilities for two million tons of ore are to be provided at Seven Islands, and ship loading facilities with a capacity of from 6,000 to 8,000 tons per hour are to be installed. The harbor at Seven Islands is ice free for about nine months of the year and probably can be kept open much longer with ice breakers.

Diesel locomotives rated at about 1,500 hp per unit will be used for haulage with four units per train. Ore cars of about 85-gross-ton capacity will be used, and locomotives will handle trains of 100 cars or more. Cars will all be equipped with anti-friction bearings and load compensating brakes. The running time between Knob Lake and Seven Islands is estimated to be about 16 to 18 hours for loaded trains.

In addition to some 2,000 or more ore cars, rolling stock will include cabooses, box cars, flat cars, tank cars, ballast cars, dormitory, dining and cook cars, as well as two snow plows, two Jordan spreaders, two wreck cars, and one or more locomotive cranes. Several locomotives and a considerable number of cars have already been delivered.

While the owners provided all equipment needed for the project, including that required for both railroad and power construction, the contractors were largely responsible for determining the amount and type of equipment necessary for the work.

Construction Equipment Chosen

Choice of equipment presented many problems. The type of excavation varied widely throughout the line, and equipment best suited for one location was not always desirable at another location. The remoteness of the project made it impossible to bring in the equipment best suited for each special type of work. In addition, the necessity of bringing in equipment by air influenced the size of the units selected. In general, the final choice was a compromise between the heavy equipment desired and the size limitations imposed by transportation requirements. The

major construction equipment in use on the job includes:

1 diesel-driven shovel and dragline, $2^1/_2$-cu yd capacity
3 diesel-driven shovels and draglines, 2-cu yd capacity
16 diesel-driven shovels and draglines, $1^1/_4$-cu yd capacity
10 diesel-driven shovels and draglines, $^3/_4$-cu yd capacity
2 mobile cranes, $^3/_4$-cu yd capacity
48 heavy tractors and dozers or scrapers
36 medium and light tractors and dozers
4 D-4 No. 104 Eimco loaders
12 No. 12 Auto Patrols
60 dump trucks, 6 to 10-cu yd capacity
100 dump trucks, $3^1/_2$ to 6-cu yd capacity
70 pickup trucks
3 trailers, 30 to 45-ton capacity
12 Snowmobiles
50 compressors, 125 to 500 cfm capacity
65 wagon drills
130 light plants
20 300-amp welding machines

The above list does not include automobiles, station wagons, or the many pieces of smaller but none the less essential equipment. The total cost of the equipment in use during 1951 was between seven and eight million dollars.

Transportation Limiting Factor

Progress on railroad construction is largely controlled by the speed at which construction equipment, materials and supplies can be moved to working points. As there are no roads in the area, the problem of supply has been a serious one. Until the end of 1951 all equipment and supplies required above Mile 12 had to be moved by air. Three Douglas D-3 transport planes and one Canso plane were used extensively in moving heavy freight and supplies. Other air transport equipment was rented for short periods. For lighter transport and exploration work, six smaller planes equipped either with landing wheels, floats or skis are used. Two helicopters are also in use. In addition to the permanent airports at Seven Islands and Knob Lake, ten other landing strips have been constructed at convenient points along the line.

During 1951 about 17,000 tons of freight was moved by air. Tote roads, particularly those for winter use, are being opened up as rapidly as possible. By the end of January 1952, a winter road had been opened all the way to Knob Lake. This road will see much use prior to the spring breakup. Later in the year, the railroad will be available to handle freight on the first 100 miles, but most of the estimated 22,000 tons of freight for 1952 (exclusive of rails and ties) will move by air.

Until end of 1951 all equipment and supplies required above Mile 12 were moved by air. Air strip at Mile 55, above, is one of ten built along railway.

Extensive exploration roads are required in the mining area, and for this use about 175 miles of all-weather roads have been constructed within a radius of 50 miles of Knob Lake.

Originally the construction schedule called for completion of the railway by August 1, 1954. Later the completion date was advanced to December 31, 1953.

Progress to Date

While construction was started in a small way in October 1950, little except camp construction and the distribution of equipment was done before May 1951, after the winter season. During 1951 about $6^1/_2$ million cu yd of excavation, or about 45 percent of the total, was removed, one tunnel 2,250 ft long was completed, and grading was done for about 70 miles of track. Late delivery of steel delayed the completion of the bridge across the Moisie River until March 1952, and limited main-line track laying to 10 miles. The completion of this bridge permits track laying to move forward rapidly.

The 1952 season should see grading completed on about 85 percent of the line and track laid to Mile 190. All bridges to Mile 200 should be in place by the end of this year.

Maximum construction force in 1951 was about 3,000 men, of which about 2,200 were engaged in railroad construction. During the winter months forces were somewhat reduced. The number employed during 1952 may exceed that for 1951 by perhaps 25 percent, most of the increase being utilized at the power sites.

Progress made to date indicates that the later schedule set for completion in 1953 will be met and that the first ore will be shipped in 1954. Production of ten million tons of ore per year can be reached by 1956.

Ore can move via the Gulf of St. Lawrence to plants along the Atlantic seaboard, by the shorter route via the St. Lawrence River and lake routes, or by overland transportation to the Pittsburgh and Youngstown steel mills. The construction of the St. Lawrence seaway would contribute much to cheaper and better transportation of ore to Midwest steel mills.

The authorized capital structure of the Iron Ore Company of Canada consists of: \$100,000,000 first and collateral $3^3/_4$ percent bonds, \$40,000,000 of 3 percent income debentures, and \$60,000,000 of common stock. Operation is supervised by Hollinger-Hanna Ltd. W. H. Durrell, General Manager, with headquarters in Montreal, is directly in charge of all operations.

This is by far the largest initial mining development in Canada. The Iron Ore Company of Canada will mine its ore from ground subleased from concession companies.

Far East needs common-sense engineering aid

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FIG. 1. Far East is generally considered to consist of countries listed in Table I. Population in 1948 was about 1¼ billion. Average density of 160 persons per square mile is six times that of rest of world and over three times that of United States.

TABLE I. Population Density in Far Eastern Countries in 1948

Country*	Pop. in Millions	Area in Thousands of Sq Miles	Av. Density in Persons per Sq Mile
1. India-Pakistan	430	1,664	258
2. Indo-China	69	784	88
3. China	479	3,790	126
4. Korea	28	85	330
5. Japan	81	144	562
6. Indonesia	78	823	95
7. Philippines	20	115	174
Far East	1,185	7,405	160
Rest of world	1,164	44,595	26
World total	2,349	52,000	45

* The numbered areas are defined as follows:

1. India-Pakistan. Besides the Indian Union and Pakistan (West and East), this area includes the small leftovers of foreign possessions in India and the adjoining countries of Nepal and Bhutan, as well as Ceylon.

2. Indo-China. This area is taken to comprise, as its original meaning indicates, the whole peninsula between the Bay of Bengal and the South China Sea. It is made up of Burma, Thailand, French Indo-China, and Malaya. French Indo-China consists of the three associated states of Vietnam (comprising Annam, Cochin-China and Tonkin), Cambodia, and Laos. Malaya includes the nine federated states, Singapore, and the settlements of Penang and Malacca.

3. China is composed of China proper, the Western Provinces of China, Hong Kong, Macao, and the Island of Formosa.

4. Korea includes both North and South Korea.

5. Japan includes Japan proper and the islands which will be left under the United States administration.

6. Indonesia consists of Indonesia proper and the islands and parts of islands under foreign control.

7. Philippines.

An aura of mystery often surrounds the Far East and clouds our thinking about these Asiatic countries where nearly half of the world's population lives on about one-seventh of its land area (Table I). In attempting to solve the problems of the Far East, sound engineering analysis and common sense are as necessary as they are in solving the problems of any other area.

Any effort to ameliorate conditions in the Far East must take into account a number of rather harsh economic realities. Although the area (Fig. 1) has considerable natural resources, they are often little known and neglected. The liberated countries have assumed the impossible task of developing their resources and improving living conditions without financial assets, credit, or profitable industrial developments. Reports of the great riches in private hands are much exaggerated. From the individual viewpoint such means may be substantial, but the individuals so endowed are so few as compared with the total population that their riches are insignificant in terms of the total economy.

Every liberated Far East country has some transportation facilities, some utilities, some mines, some fabricating and other industries. All that was built up in the past by the colonial powers. Most of it is intact; some was destroyed in war and has not yet been restored. But everything is incredibly small and inadequate considering the population. Conditions must be changed and new industrial life brought in.

Some blocked pounds sterling owed by Great Britain to former colonies, which are being paid back in small installments, represent the most substantial financial assets available to India, Pakistan, Burma and Ceylon. The other countries of the Far East do not even have that much.

Greatest Problem Is Food

The Far East is in a bad way as regards food. Rice, particularly adaptable to cultivation in the area, is the staple food. With the exception of West Pakistan and a few northern areas of India, the people depend entirely on this crop, so that statistics of rice consumption give a clear picture of living conditions as far as food is concerned. This dependence on a single crop is more pronounced in the Far East than anywhere else. Taking 500 lb of rice per capita per year as the reasonable minimum consumption, it is seen from Table II that only Malaya and Japan have an adequate food supply. Since 1916 the food situation in the region as a whole has been slowly deteriorating. Only in the Philippines, Indo-China, Malaya and Ceylon did conditions improve. Japan kept her consumption up better than most by drawing heavily on Korea and Formosa. India, under British rule, was similarly drawing on Burma.

Regions that formerly exported food had become so deficient in rice production by 1940 that widespread starvation could only be averted by importing food. Purchase of food in a high-cost country and its transportation to a low-cost country makes the imported food cost several times what the local food costs. Since all Far East countries are low-cost countries, none of them can afford to

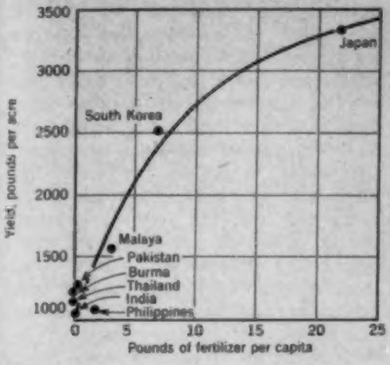


FIG. 2. Effect of fertilizer on rice yield in countries of Far East is shown by curve based on data in Tables III and IV. Fertilizer production to raise crop yield is badly needed.

TABLE II. Per Capita Consumption of Rough Rice

In pounds per year in 5-year averages

Country	1916–20	1921–25	1926–30	1931–35	1936–40
Malaya	...	588	640	600	647
Japan	525	528	518	615	500
Ceylon	...	440	454	440	454
Burma	563	560	525	405	434
Formosa	545	502	521	416	382
Indo-China	363	370	384	372	395
Philippines	345	408	427	377	387
Thailand	440	606	472	407	320
Indonesia	378	353	331	305	302
India and Pakistan	331	310	384	289	264
Korea	317	272	222	190	211
Total	366	360	337	331	313

Note: Production, exports and imports are considered. Less than 500 lb per capita per year is inadequate. China is not included because statistics regarding it are unreliable or non-existant.

import food at regular market prices without committing economic suicide. Except for the generous help proffered by the United States in one form or another to such countries as Japan, Korea, and India, they would be in the midst of a famine unparalleled in centuries.

Such help obviously cannot be extended indefinitely, and means must be found to improve conditions. Four remedies present themselves—to evacuate a large part of the population, to introduce a sustained and vigorous birth-control program, to increase food production, and to industrialize the countries rapidly. The first is obviously impossible since there is no country that could, or would, assimilate such an influx.

The second proposal—birth control—could be of considerable help. India's prime minister, Jawaharlal Nehru, recently stated with remarkable frankness that planned parenthood has become one of the important issues in India. But obviously in India, as well as in the other Far Eastern countries, deep-seated beliefs and customs are against it. A change in the habits of a thousand years is inevitable, but it will take decades, perhaps even centuries, for realization.

The third and fourth remedies suggested—to increase food production, and simultaneously to further industrialization—are for the present the only practicable solutions. Industrialization must obviously be accompanied by an improvement in the food situation. If food production could be increased, the foreign exchange now being spent on food imports could be used for industrialization. Actually in most of the Far East, food production is not improving, and the best that can be expected for many years is that the situation will not become worse.

In many cases the food customs of the population, based largely on religious concepts, have a bearing on the food shortage. There is no country where the idea of the Commandment, "Thou shalt not kill," is taken more literally than in India. One sect will kill neither animals, fish, nor insects. Others permit the killing of beasts of prey. But no Hindu will kill or permit the killing of a cow. A substantial group will not only not touch meat, but refuse eggs, milk and fish. Some will eat fowl, but beef is generally tabu. Although these people may be starving they will not touch the animals that roam around and actually constitute a sanitary hazard as well as a nuisance, besides consuming, themselves, food needed by the people.

However, the main reason for the food shortage in the Far East is that although some attention has been paid to increasing the acreage under cultivation, very little consideration has been given to improving agricultural methods.

Irrigation is of course important. Most of the Far East countries are in "monsoon" areas, where practically all the rainfall, though ample, is concentrated in four months of the year. Water storage and irrigation are the obvious answer. Irrigation not only permits an increase in the area under cultivation, but in many cases the raising of two or even three crops a year on the same land.

The emphasis on new irrigation projects, which appeal because they are spectacular, may be dangerous. It represents the way of least resistance. The results of this policy of directing all efforts to increasing the acreage of irrigated lands are well illustrated in Table III. The difference between the very-high-yield and the low-yield countries is startling. Yet in such countries as Burma, India and Thailand, the soil and climatic conditions are better than in Japan. Japan, the only country in the very-high-yield group, deserves special attention.

Besides better tilling of the soil and the use of better seeds, the most important factor responsible for Japan's high yield has been the production and extensive use of fertilizers. No other Far East country has done anything comparable in that direction.

China's comparatively high yield is due partly to careful cultivation and partly to the fertile silt deposited on the rice fields by rivers, but chiefly to the natural fertilizers which are spread over the fields in larger amounts than in any other country. Every known natural fertilizer is utilized—manure, village compost, green manure (decomposing green crops), dried fish, and bone.

The situation in the low-yield countries is due to insufficient silt deposits and to neglect of natural and manufactured fertilizers. For instance, India today has more irrigated land in cultivation (50 million acres) than any other country in the world. But the efficiency of utilization of both irrigated and non-irrigated land (243 million acres) is very low. No artificial fertilizers are available and no live-stock ma-

nure reaches the fields. Whatever there is, is dried and used for fuel or mixed with mud to form bricks for house construction. Elements removed from the soil are not replaced even in part. Conditions are still worse in irrigated areas, where the opportunity to raise two or three crops a year still further exhausts the soil.

An understanding of the importance of fertilizer utilization may be obtained by comparing the per capita consumption of fertilizers in different Far Eastern countries with crop yield. See Tables III and IV and Fig. 2. The difference between Japan and the rest of the countries in fertilizer consumption is as startling as the difference in rice yield.

To discover how much fertilizer would be required to properly utilize the agricultural possibilities of the Far East, Japan has been taken as a model. To equal the per capita use in Japan, 4,800,000 tons of nitrogen would be required, of which only 500,000 tons are produced; 4,100,000 tons of phosphoric acid would be needed, of which only 340,000 tons are produced; and 1,800,000 tons of potash would be called for, of which none is produced.

Nitrogen fertilizers can be produced by using fuels such as coal, oil, gas, electricity, or even wood. Coal is scarce in the Far East, and oil and gas are available only in Burma and Indonesia. It becomes therefore of great importance to utilize hydroelectric energy for the manufacture of fertilizers. This is particularly true in India, where the undeveloped hydroelectric power is practically unlimited. It is of interest that, on March 2, 1952, a new fertilizer plant capable of producing 1,000 tons of ammonium sulfate a day was opened at Sindri, Bihar State, India.

Industrialization—Yes, but How?

The need for industrialization of the Far East is axiomatic and need not be defended here. What should, however, be made clear is the basic method to be applied. Is there some miraculous method of imposing industrialization from the top down, thus transforming an undeveloped agricultural country into a highly developed one in a short time? Or must industrialization be developed gradually, bit by bit, by hard and consistent work?

If unlimited means were available the first method would be possible; otherwise the second must be followed, much as has been done in the past in Japan. It is my belief that, in the Far East, one of the first and basic goals of industrialization is to increase the food supply. That means agricultural machinery and fertilizers. Japan is the only Far East country that has developed its industries in any way comparable to the West.

The first requirement for industrialization is electric power. In the Far East distances are great and power demands small. In many of the countries, several decades must pass before a satisfactory grid can be created. Of course countries adjoining the Himalayas possess very large hydro-power potentialities. Here all the heavy electric-demand industries could be located. Numerous potential sources of hydro power of much smaller magnitude are spread over most other countries of the Far East.

Rising Sense of Nationalism

At present there is a rapidly growing feeling in the countries of the Far East that to continue to follow blindly the precedents established during thousands of years is not the best possible course, and that something should be done to raise the living standards of the masses. Two radically different approaches are developing. One is that the past not only is of no importance, but is degrading and must be forgotten, and that progress must follow the materialistic theories of communism. The other is that the Far East should have a renaissance, and that agricultural and industrial improvements should be based on the tremendous cultural values of the past.

Proponents of the second viewpoint sometimes find it hard to face realities. The glories of the past and the intensified national feeling make them reluctant to ask for or accept whole-heartedly the assistance that may be offered, in particular by the United States. A considerable amount of face saving must be done. Seldom will it be admitted that help is necessary and that without it no progress can be achieved.

It must be made clear that psychologically, financially and technologically it is impossible to take a Far East country and transform it into something closely resembling the United States. Each country will retain its own character no matter how much money and effort we might pour into it.

During the last few years the Far East countries have been visited by a number of experts with the American point of view—that the larger the development the better, and that no matter how large it is, it can be utilized. Such a viewpoint easily meets with the approval of local officials on the assumption that if an expert advocates a development he knows where the financial means will come from to build and utilize it. As a result considerable work has been done and large sums spent to design projects of such exceptional magnitude and such high cost that they cannot be built for decades.

Considering the overall economy of the low-cost Far East countries, which are in the first stage of industrialization, it would be far more advantageous to provide a number of small or medium-sized hydro developments combined with irrigation and spread over the country. The same applies to other projects. Instead, expensive and complicated manufacturing plants are proposed and taken very seriously. The crying need is for fertilizer and agricultural machinery plants, yet much more time and effort are being spent on blueprinting aeroplane factories.

Foreign experts should consider it their first duty to resist this desire for uneconomic, oversized and spectacular projects. They should use their technical knowledge, experience and common sense to select projects that will fit into the economy of the country in a realistic way.

Another consideration of importance is that no one can go to the Far East today and be of any use if he has that relic of the past—a superiority attitude. He must mix with people both in business and socially and try to understand them. The fact that they do not act or think as he does does not make them inferior—just different. If he acts in the right way he will discover, as many have before him, that he is dealing with a most delightful and hospitable people, ready to go considerably out of their way to make his stay in their country enjoyable and fruitful.

Restrictions on Capital

Governments of the liberated countries, largely because of the methods by which liberation was achieved, are socialistic in varying degrees. Their inability to meet practical economic problems is illustrated by their attitude toward financial matters. The idea generally was that after liberation, international capital, chiefly from the United States, would come in in tremendous amounts. That was one of the reasons for preparing blueprints for the bigger and more expensive projects. Because they feared being swamped by foreign capital or losing their economic independence, they set up legal re-

TABLE III. Yields of Rough Rice, in Pounds per Acre

Country	1934–38 Average	1947	1948	1949
Very-High-Yield Group				
Japan	3,250	3,230	3,320	3,350
High-Yield Group				
Korea, So.	2,280	2,210	2,445	2,520
Formosa	2,200	1,825	1,900	2,250
China	2,255	2,260	2,260	2,145
Medium-Yield Group				
Malaya	1,530	1,440	1,300	1,565
Indonesia	1,400	1,285	1,300	...
Pakistan	1,315	1,220	1,315	1,255
Thailand	1,280	1,120	1,145	1,130
Burma	1,262	1,325	1,215	1,200
Low-Yield Group				
India	1,168	1,080	1,045	1,040
Indo-China	1,035	1,185	1,030	1,005
Philippines	976	1,020	1,020	1,060
Ceylon	872	576	585	...

TABLE IV. Fertilizer Utilization in Far East, 1950–1951

In pounds per capita of Nitrogen (N), Phosphoric Acid (P_2O_5) and Potash (K_2O)

Country	N	P_2O_5	K_2O	Total
Japan	10.75	7.65	3.31	21.71
Korea, So.	4.40	2.20	0.22	6.82
Ceylon	3.76	0.47	1.87	6.10
Malaya	2.35	0.09	0.54	2.98
Philippines	1.76	...	...	1.76
India	0.41	0.11	...	0.52
Indonesia	0.30	0.03	...	0.33
Pakistan	0.17	...	...	0.17
Thailand	0.13	...	...	0.13
Burma	...	0.01	...	0.01

strictions regarding earnings, export of money, labor relations, government control, and possible nationalization. The rude awakening came very soon, when not even a normal inflow of private capital developed.

Some comments by Eugene R. Black of the International Bank are pertinent:

"We all know of many cases in which local capital is sent abroad or hoarded in the form of gold, commodities, or land that is not put to productive use. We know of countries where individual wealth finds speculative trading profits more appealing than investment in manufacturing or other productive enterprises. As long as governments and peoples do not pay sufficient attention to the environment in which capital must grow and work, it is hard to see how the case could be otherwise. Yet if a country cannot induce its citizens to put their own capital into productive enterprises at home it cannot reasonably expect to attract capital from abroad."

At present exaggerated hopes are being placed on help from the International Bank, Point IV, the foreign assistance program of the United States and the United Nations. It will take some time before the truth will become evident that no country can expect foreign help unless it is willing to help itself. Foreign capital does not go to a country where political stability is uncertain and where everything is done to reduce or eliminate a return on such capital.

The fact is that little private capital will be available, and whatever financial aid materializes will come from the United States and some international agencies. The problem is thus reduced to devising means by which the meager income of each country can be utilized to the best advantage.

Of no mean importance will be our help in developing a common-sense attitude among Far Eastern engineers and officials. In the United States because of our wealth and production capacity we often do not do things in the most economical way, particularly as concerns governmental capital expenditures. The countries of the Far East cannot afford such extravagances. Also, many of our labor-saving devices are meaningless where the cost of capital is high and that of labor is low, and this situation will continue for a long time to come. Under such conditions methods we take for granted may be highly uneconomical, even plainly ridiculous.

It is natural that after the decision had been made to industrialize their countries, engineers and non-engineers from the Far East came to visit Europe and the United States to study our industries. In most cases this study consisted of visits to the outstanding plants of the country. It is again natural that the visitors would prefer to see, and that we would be most anxious to show, the most modern and spectacular establishments. These foreign engineers then returned home with the dreamy idea that it would be nice to build in their country, say, a Ford factory or a great hydro plant, or even an atomic-energy plant.

They have little understanding of the enormous organization, engineering and research work that lie behind such engineering achievements, still less, that the establishments inspected represent economic and financial accumulations of one or more generations. No thought is given as to how such a project will fit into the economy or their own country.

A small number of the visitors are young engineers who come to work and to learn how to do things in the hard way, from the ground up. But when they return home they seldom have such opportunity, since the whole engineering profession in the Far East is based on seniority. No industrialization is possible unless the new generation of engineers are permitted to assume leadership before they fall back into the deep rut of tradition. Only a small percentage of Far Eastern engineers can ever expect to go abroad, and even if they do, very few can stay long enough to accumulate experience.

The only solution seems to be to have capable foreign engineers provide the guidance so sorely needed until a new engineering generation can take over. Unfortunately the general tendency in the Far East is to keep foreign experts in subordinate positions. It should be realized that, in order to overcome the general inertia and other drawbacks, a certain amount of authority is indispensable.

Such an assignment for an American engineer is not easy. He will find at first that everything seems to be against him—climate, food, the way of living, facilities, the general inertia, even the administrative machine. To obtain any results he will have to work very hard, possibly harder than he ever worked before. But he will have the satisfaction of knowing that if, with the support of the younger engineers, he is able to overcome even a few of the obstacles, then he has achieved something of lasting benefit. What engineer can ask for more?

Ways to cut building costs shown by

General Accounting Office Building,

Methods of cutting costs were carefully studied in connection with the design of the Government's General Accounting Office Building in Washington, D.C. Some of the more significant construction shortcuts that resulted are brought out in this article. The building, now substantially complete, had just been placed under contract when it was discussed in the symposium, "Putting More Sense Into the Public Construction Dollar," printed in CIVIL ENGINEERING for February 1950, based on the symposium held by the Construction Division at the Society's 1950 Annual Meeting in New York.

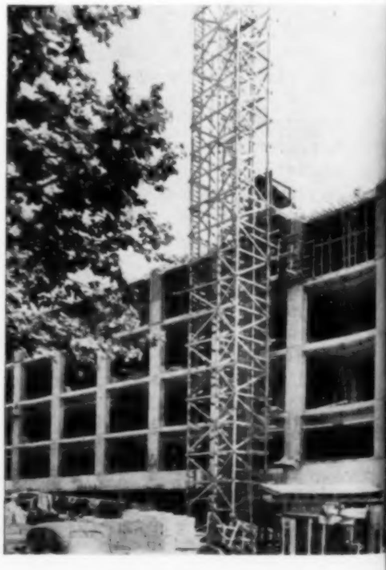
It is fundamental that any structure should be built at the lowest economic cost and still meet the purposes for which it was designed. Economic cost, when applied to an office building such as the General Accounting Office Building in Washington, D. C., not only must include capital investment but also must allow for future maintenance and operation costs and provide for the maximum potential efficiency of those who occupy the building. And to secure such maximum potential efficiency, psychological and physical factors, such as air conditioning, lighting, color, and acoustics must be given due weight.

The General Accounting Office Building had to house 9,000 people engaged in work which permits large, partitionless spaces. Columns had to be spaced as far apart as possible and column spacing and fenestration had to be chosen so as to provide proper subdivision of bays for private offices. The need for extensive files in certain areas made the live load requirements higher than usual for office buildings.

To determine the various factors precisely, it was necessary to establish certain fixed standards of space allocation for each particular activity, including the necessary services and facilities, and also to fix the size of standard office furniture

Foundation rests on Raymond step-taper piles of 40-ton bearing capacity. Steel columns, encased in concrete, were used in basement and subbasement to obtain maximum floor space in parking areas. Start of deck work is seen at extreme right.

Superstructure of new General Accounting Office Building is reinforced concrete flat-slab construction with conventional caps and



Washington, D.C.

W. E. REYNOLDS, M. ASCE

Commissioner of Public Buildings, General Services Administration, Washington, D.C.

Design of General Accounting Office Building in Washington, D. C., was made with a sharp eye on costs. Minimum of architectural embellishments and maximum use of repetitive units were significant factors in bringing cost of structure down to one dollar per cubic foot.

and the location of lighting units. On the basis of extensive studies, all interior bays were made 25 ft square, and the depth of the perimeter bays was reduced to 18 ft.

A government building on the land which was available for construction was subject to the limitations set by the National Capital Park and Planning Commission regarding setbacks from streets and the envelope of the building. These factors limited the height to seven stories, exclusive of a machinery floor on the top.

Before adopting the block-type building, comparisons were made between this type and a standard wing-type structure. It was found that the block type produced considerably more net usable area in view of the type of operations involved and—a very important point—reduced the percentage of outside wall to floor area from 30 to 14 percent. The block type materially lowered the amount of heating required in the winter and of air conditioning in the summer. On the strength of these and other recommendations, the block-type design was adopted for the structure.

The exterior of the building is plain but architecturally acceptable. The base is polished granite with limestone facing above. Only three sizes of limestone were used, permit-

drop panels on square, spirally reinforced columns. Generally two towers were used for elevating concrete.

Extensive area of building permitted pouring of second-floor slab at one end of block while foundation piles were still being driven at other end. Horizontal movement of forms was therefore possible to much greater extent than in conventional shaft-type structures.

ting almost endless variation and reducing cost.

There are a limited number of fixed partitions in the building, although most partitions are of the movable type. Experience has shown that fixed corridors are preferable for service as collection and distribution channels for large numbers of people, and for guiding people to fire towers in the event of fire or panic.

The aluminum, inswinging casement windows are especially noteworthy. The inswinging feature was adopted to facilitate washing, and makes possible a saving of about 50 per cent in window washing costs. Each window has a lock so that it cannot be opened except by direction of the superintendent.

Other facilities in the building include feeding service for 2,000 people at one seating, a 250-seat auditorium, a library with a capacity of 50,000 books, and garage facilities for 800 cars. Our policy is to provide car parking facilities for 10 percent of the population of a building. Also included are appropriate spaces for maintenance shops, custodial storage, and other mechanical spaces for the physical functioning of the building.

Air Conditioning and Ventilation

Twenty-five air-conditioning units, ranging in size from 7,200 to 60,000 cfm, serve the executive offices, library, auditorium, cafeteria, and 21 inside and outside zones. Fresh air and return air are cooled in separate dehumidifiers, thus eliminating the conventional bypass with its uneconomical use of space and duplication of air filters. Provision is made for taking all air from the outside whenever refrigeration can be saved by so doing.

Air distribution generally is through ceiling diffusers, but low-pressure window mixing units and perforated ceilings are used in a few areas. Returns are taken through grilles generally located on or near eight large shafts. Air from areas remote from the shafts will reach the return grilles by way of grilles or louvers placed in the partitions. Return ductwork is thus kept to a minimum. A smoke detector system is provided to shut down the supply fans, to close dampers in the return connections to the units, and to open the return shafts to the outside in case of fire. Refrigeration is provided by four 1,050-ton centrifugal refrigerating machines arranged in line under a 10-ton crane to facilitate the handling of heavy parts for cleaning and servicing.

Lighting in all general office areas and reading-room portions of the library is of the indirect fluorescent type. The system provides not less than 30 ft-candles with a minimum of direct and reflected glare. Particular attention was given to securing brightness ratios well within the usually accepted rule of three to one for satisfactory office lighting.

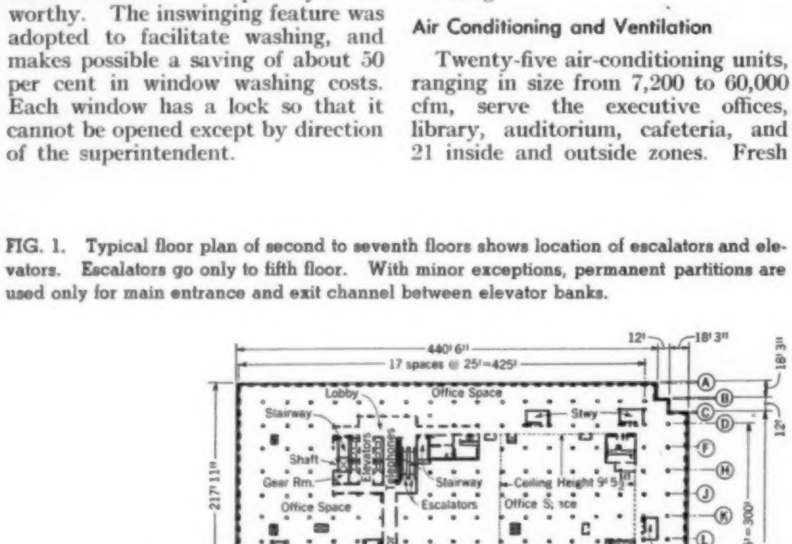
The plumbing system for the building includes the customary facilities for toilet rooms and gear rooms, drinking fountains, vacuum cleaning, fire protection and roof drainage. In the toilet rooms, the fixtures are of the hung type to minimize cleaning costs. Drinking fountains are located approximately 200 ft apart throughout the building and are served by a central cooling system of 50-ton capacity that circulates 60 gpm of water at 50 deg F.

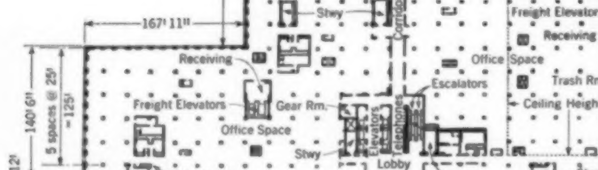
There are five vacuum cleaning systems, each of 15-sweeper capacity. Outlets are so located on each floor as to give complete coverage with the use of 50-ft lengths of hose.

Steam Service and Heating Systems

Steam is supplied to the building from the Government Central Heating Plant distribution system at a gage pressure of 250 psi. The initial or main reducing valve station, serving nine additional pressure reducing valve stations, is of the single-stage type, reducing the pressure from 250 to 100 lb for distribution throughout the building. The various sub-

FIG. 1. Typical floor plan of second to seventh floors shows location of escalators and elevators. Escalators go only to fifth floor. With minor exceptions, permanent partitions are used only for main entrance and exit channel between elevator banks.





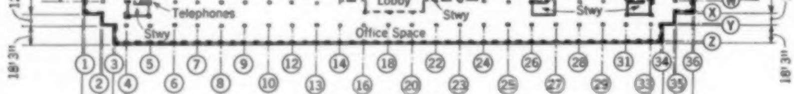
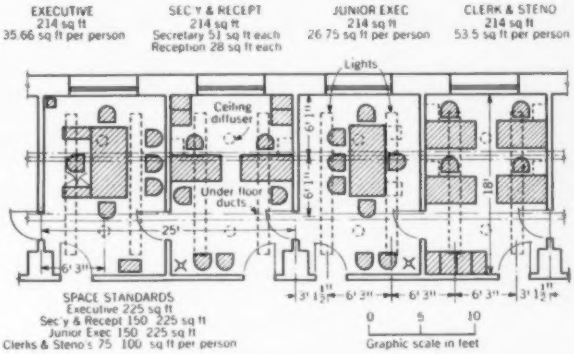


FIG. 2. Transverse and longitudinal sections show repetition of vertical and horizontal dimensions which permitted maximum reuse of forms, thereby cutting costs considerably.

Interior of building is finished with uninterrupted acoustical ceiling with luminous indirect lighting fixtures. Most partitioning is of movable type; fixed partitions are limited to fixed collection and distribution channels for large numbers of people.

FIG. 3. Studies of spatial requirements and desk positions—such as that shown at right—were made to determine fenestration, column spacing, and location of fixtures.



stations supply steam at reduced pressures to kitchen equipment, fan blast heaters, hot water generators, and building heating systems.

The building is heated by a two-pipe down-feed steam system with gravity returns. The steam main, which supplies the risers, is located in the furred ceiling of the seventh floor. The entire system is arranged in four zones, each automatically controlled by a steam valve which in turn is actuated by a master outdoor thermostat with a bulb conveniently located for immediate response to varying outdoor temperatures.

Each of the two vertical circulation areas for handling passengers (one at each main entrance to the building) includes a bank of six gearless passenger elevators operating from the subbasement to the seventh floor, and up and down escalator units operating from the first to the fifth floor.

The passenger elevators have a 5,000-lb capacity, a speed of 500 fpm and are equipped with generator field control and signal operation. In addition, provision is made for automatic operation of each bank under supervision of an attendant on the first floor, and for automatic night operation of two cars in each bank. This is the first major installation of its kind in a government building and its reception by the public has been excellent.

Extensive borings showed the presence of an old stream bed below the elevation of the subbasement floor, as indicated on old maps. The site was overlain by a clay stratum varying in depth and character and disappearing in the north and northeast portions. Under this clay, and extending to an average depth of 32 ft below the floor, were found sand or sand and gravel containing clay lenses, with pockets of fine sand and organic matter, clay and peat and decayed wood at varying depths. These pockets occur at footing level in part of the site.

Gas under sufficient pressure to blow water 20 ft into the air was encountered in two borings in the northeast quadrant. Artesian water was found in four borings on the north half of the site at elevations varying from 80 to 90 ft below the basement level. Eighteen monotube test piles were driven adjacent to the borings and so distributed as to cover the entire site and probable combinations of strata. The test borings and soil profiles, which anticipated the spotty character of the soil, were confirmed by the driving records.

Load tests were made on a concrete step-taper pile, on a monotube cast-in-place concrete pile and on a steel H-pile. These piles were driven in line, 10 ft apart, with the steel H-pile in the middle. The concrete piles were simultaneously loaded by calibrated hydraulic jacks reacting on steel beams. The beams were loaded with an earth-filled wood box $30 \times 20 \times 8^1/_2$ ft high, supported on concrete end walls. The steel H-pile was loaded as soon as practicable after completion of the test on the concrete piles.

The concrete piles were loaded to 120 tons in increments of 10 tons, and two H-piles were loaded to 220 tons in 15-ton increments. Load increments were applied when the rate of settlement decreased to not more that 0.01 in. in $1^1/_2$ hours, except that double the design load was held constant for 3 or 4 days and all loads were held constant over night. Loads were released in the same increments and at the same rate of recovery but without variation. Loading required six days, exclusive of the time during which double the design load was held constant, but only half that time was required for unloading.

Differential and time settlement studies of a spread-footing foundation were made from the results of laboratory tests on Shelby tube samples by the Bureau of Public Roads. A spread-footing design proved to be unsuitable because of the low allowable bearing pressures, variable character of the soil, large differential settlements, and excessive cost of providing deeper footings.

Three optional types of pile foundations were prepared, two for cast-in-place cased concrete piles, driven with or without a mandrel, at 30 and 40 tons per pile, and one for steel H bearing piles at 60 tons per pile. Raymond Concrete Pile Company's step-taper piles at 40 tons were selected by the contractor, who drove 7,725 piles averaging 44.5 ft in length and varying from 28.6 to 67.4 ft.

Superstructure of Reinforced Concrete

In general, the superstructure is standard skeleton construction of reinforced concrete, using conventional flat slabs with caps and drop panels on square, spirally-reinforced columns spaced 25 ft on centers. To obtain maximum space in the automobile parking areas, the interior columns in the basement and subbasement are designed with structural steel cores encased in concrete. Seat angles are provided to receive the flat slabs. Where the reinforcing bars in the top of the slabs are intercepted by the

steel columns, they are welded to them. Where the transition from the steel cores to the concrete occurs, steel billet-plates are welded on top of the steel columns, and then stub reinforcing bars are welded to the top of the plates to transfer the stress.

Study was given to the probable live load with relation to unit cost. It was found that the General Accounting Office requires about three times the file space needed for a normal federal building. A considerable part of these files are approximately 9 ft high. A basic live load of 125 psf was selected with reduction in proportion to the area carried by the slabs, columns and footings. The formula used was developed by this office and adopted by the American Standards Association and the American Institute of Steel Construction.

No expansion joints are provided in the structural frame. However, control joints are placed throughout the floor system and the concrete walls midway between alternate columns, or approximately 50 ft in each direction. The exterior wall facing is supported on horizontal steel relieving shelf angles at alternate floors. A pressure-relieving joint below the shelf angle prevents the transfer of load to the veneer below.

The General Accounting Building, including architectural and engineering services, cost almost exactly \$1.00 per cu ft. On an area basis, the cost, including the garage portion, is approximately \$12.50 per gross sq ft. A wing-type structure, with its greatly increased outside wall surfaces, larger air-conditioning and heating costs, and attendant factors, would have cost an estimated 20 to 25 percent more.

The construction of the building was attractive to both general contractors and subcontractors because of the great repetition of construction units and simplicity of design. The ground area was sufficiently large to permit concrete pouring on the second floor at one end of the block while foundation piles were still being driven at the other end. This allowed horizontal movement of concrete forms to a much greater extent than is possible in shaft-type structures. The absence of wings or courts in the block-type design adopted, magnified the above advantages.

In this discussion of the design and economics of a block-type office building, two disadvantages of this type should be noted. First, the building is too wide for good office use. A building code requirement that fire stairs must be within 150 ft of every worker forced these elements away from the axis of the building, thus requiring many people to work in spaces without a view of the outside. This disadvantage also occurs where private offices are located along the perimeter and solid walls of opaque glass are used. To prevent claustrophobia most workers in a building should be able to look out-of-doors. However, considerable latitude may be permitted in the distance from worker to window and also in the proportion of glass area to outside wall surface.

Secondly, flat-slab construction requires that vertical piercements be made in the center of the bays. Some disturbance of the open plan results and cuts off the view of occupants, even in very large interior spaces. The usefulness of the bay that is pierced by the vertical shaft is also decreased.

It has been concluded from these considerations that the width of a block-type office building should be limited to 250 ft. This width permits a main or spinal corridor down the center of the building and the location of all facilities adjacent to it. Private offices would then be placed on the spinal corridor or on phantom corridors at right angles to the spinal corridor. Exterior spaces would be used for clerical purposes. Thus there would be an uninterrupted band of clear office space around the outside of the building on all but the first floor.

The General Accounting Office Building was designed and constructed under the supervision of the Public Buildings Service of the General Services Administration. Credit is due to Gilbert Stanley Underwood, Director of Design and Construction, and Christian David Persina, Chief of Design, both acting under Allan Stewart Thorn, Supervising Architect; and to Ralph Bauer, Construction Engineer, acting under Otis R. Poss, Supervising Engineer, all of the Public Buildings Service. The contractor was John McShain of Philadelphia, with Paul Hauck, Washington manager, in charge.

How costs were cut

The contractor felt that basic economies were produced by the following factors:

1. The block-type plan, which increases the ratio of the volume of the building to the exterior wall area.

2. The great amount of repetition of standard units, such as standard bays, a common window size, a limited number of exterior stone sizes, and the small number of variations in color and finishes for standard rooms, such as offices, maintenance and custodial rooms and toilet rooms.

3. The cheapest available finish (shot sawn) for the exterior stone, which is particularly suitable to the large scale of the building.

4. Elimination of fussy architectural embellishment. (The restrained sculptural ornamentation adopted is used only at the two entrances.)

5. Elimination of all parapets, thus reducing maintenance costs. (Omission of parapets is a standard Public Buildings Service practice.)

6. Use of a small amount of simple molded stonework.

7. Reduction of window reveals to the thickness of the stone facing.

8. Reduction of the thickness of the stone facing to 3 in.

9. Use of the flat slab with column capitals and drop panels as the basic structural floor.

10. The resulting easy, and less expensive, distribution of mechanical services.

11. Use of flush ceilings throughout the building, with lower story heights than would have been possible with beam-and-girder construction.

12. Standardization in size and finish of all similar rooms, such as custodial rooms, gear rooms, and toilet rooms.

End-welded studs save tax dollars and United States Navy time

When reconditioning the Leonardo, N. J., pier facilities of the Earle U. S. Naval Ammunition Depot, it was found necessary to replace the railroad tracks on the piers. The track was worn to the point where safe operation was questionable and it was decided to replace with heavy rail. The old track was secured to the concrete piers by long bolts with their heads embedded in the concrete. Investigation showed that many of the bolts had been seriously corroded at their thread ends.

To chip out and replace the bolts would have involved a long program and heavy expense. As an alternate plan, threaded studs were end-welded to the old cut-off anchor bolts.

The rails were stripped from the piers and pneumatic chip hammers were used to remove existing grout. The bolts were cut off above the bottom of the concrete trough with an acetylene torch. Enough of the bolts were removed so that sound metal was reached on all bolts. Bolt heads remain embedded to a depth of 6 in. below the trough bottom. Then threaded Nelson studs, $^3/_4$ in. in diameter by $3^1/_2$ in. long, were end-welded to the bolts with a semi-automatic Nelson stud-welding gun. The method effectively extends bolt lengths so the new rails can be placed.

The correct rail height is obtained by putting a layer of grout in the bottom of the rail trough. A wooden cushion plank rests on top of the grout. Rails contact steel plates that rest on the cushion planks. They are held in position by clips that are anchored by nuts run down on the threaded stud extensions of the original bolts. With two guns, the average rate of stud application was 500 per day.

Tests completed by the Navy show that the butt welds produced can take an 18,000 to 19,000-lb tensile load before fracture. Using a standard track wrench with a 4-ft pipe extension, workmen stripped the threads from the stud without failure at the weld end.

The result has been completion of a job of vital importance in a manner that will ensure its usefulness long after the present world emergency is terminated. The use of new material has been kept to a minimum and the salvage of existing material has been a maximum, both factors of importance, in addition to time and money savings, in the present emergency.

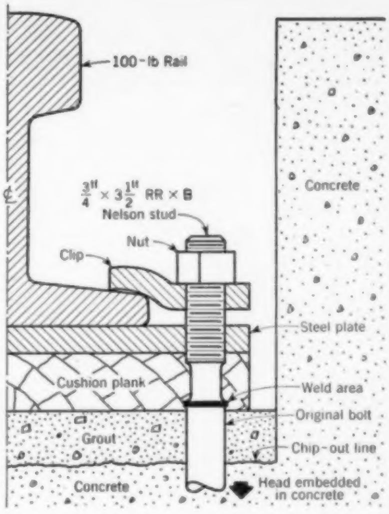


FIG. 1. Threaded studs, end-welded with a Nelson gun to existing bolts embedded in concrete constitute the method used at the U.S. Naval Ammunition Depot, Earle, N.J., to replace railroad rails on their concrete piers at Leonardo.

ENGINEERS' NOTEBOOK

Simple physical properties of a soil mass shown by curves

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A chart showing the relationships between simple soil properties has been of some value in soil laboratory work and of appreciable value in teaching soil mechanics to undergraduates, both in lesson preparation and as a visual aid in classroom work. The idea of such a chart is perhaps not original with the writer, but he has not encountered in current texts or publications any such graphical presentation of the relationships between the simple physical properties of a soil mass.

This chart, Fig. 1, plots the families of curves of the following two basic equations:

$$\gamma_m = G_s\,\gamma_w\,(1 - n)\,(1 + w)$$
$$\gamma_m = (S\,n - G_s n + G_s)\,\gamma_w$$

in which

n varies from 0.2 to 0.6
w varies from 0 to 50 percent
S varies from 0 to 100 percent

The notation employed is

γ_m = unit weight of soil mass
γ_w = unit weight of water
G_s = specific gravity of soil particles
n = porosity of soil mass
w = water content in percentage of dry weight
S = degree of saturation

The specific gravity has been held at 2.68. This figure was chosen because it is often used by the Waterways Experiment Station, Vicksburg, as a general average.

In addition to use as a general calculating device, the chart has been valuable for classroom discussions and calculations relative to the following:

1. **Field density testing.** The wet unit weight and moisture content are determined, and the "location" of the sample on the chart is found. The dry unit weight is of course the unit weight corresponding with the zero moisture content line at the field void ratio. Illustrative "locations" are indicated by points A and B.

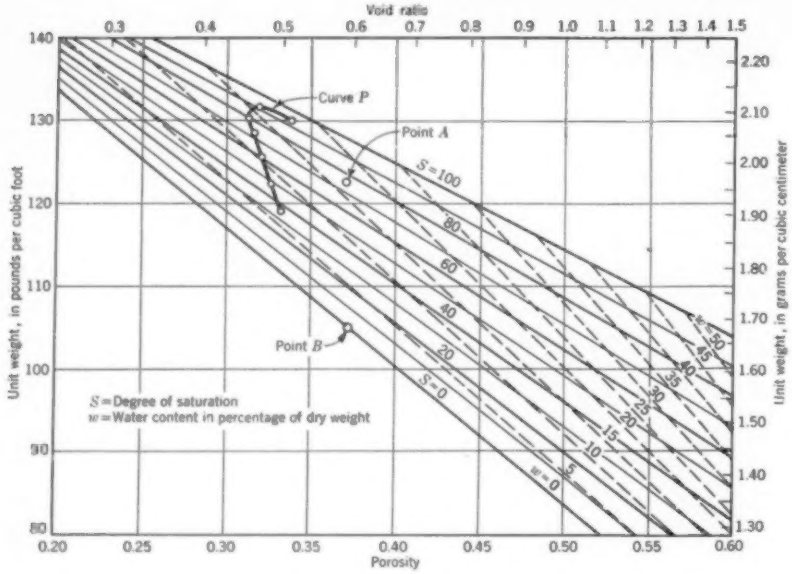

FIG. 1. Relationships between simple soil properties are plotted according to percentage of saturation and water content in percentage of dry weight.

2. Proctor compaction curves. Proctor compaction curves may be plotted directly as moist unit weights, as shown by the illustrative curve P. Optimum moisture content and maximum density are taken directly without calculating a "dry curve." This is of possible value in speeding testing time and eliminating some simple calculations. The principal value here is for classroom presentation of the change in void ratio and saturation as moisture content varies with constant compacting effort.

3. Shrinkage limit and ratio. Shrinkage limit and ratio are interrelated properties, each being a function of the other and of the specific gravity of the soil particles. The lectures discussing this relationship and the simultaneous changes in void ratio, moisture content, and the percentage of saturation have been improved by the use of the plot as a classroom wall chart.

This chart was prepared while the writer was working under the auspices of the University Research Committee of the University of Alabama.

Methods of general application developed for finding peak flood flow

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Flood-flow determinations are often required at locations for which no gaging records are available. After the flood has passed, a field survey is made at the desired location to determine the physical features of the flood channel as they existed during the flood. These data are then analyzed by applying the Manning formula to determine the peak flood discharge. It is believed that there is need for a reliable method of determining the peak discharge which will be of general application. Such a method is here presented.

The example chosen to illustrate the method is taken from Water Supply Paper 773-E, U. S. Geological Survey, pages 252 and 253, which gives the basic data, as determined by a field survey, for a flood on Glen Creek at Watkins Glen, N.Y. This example has been chosen because it illustrates both cases that may occur in practical experience: (1) where the slope of the energy gradient is greater than the water-surface slope, and (2) where the slope of the energy gradient is less than the water-surface slope.

The basic data for this example as determined by others are given in Fig. 1 and Table I. In Fig. 1 is

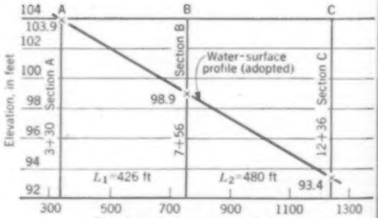


FIG. 1. Curve shows water-surface slope or hydraulic gradient adopted as representative of flood peak on Glen Creek at Watkins Glen, N.Y

TABLE I. Values for Manning Formula Computed from Field Data ($2g = 64.4$)

	Sect. A		Sect. B		Sect. C
El. of water surface	103.9		98.9		93.4
A, sq ft	1,377	1,256	1,136	1,214	1,293
R, ft	13.2		12.0		11.7
$R^{2/3}$, ft	5.58	5.41	5.24	5.20	5.15
$1.486\ AR^{2/3}$	11,400	10,120	8,840	9,380	9,910
L, ft		426		480	
El. of energy gradient	$103.9 + \left(\frac{Q}{1,377}\right)^2 \frac{1}{2g}$		$98.9 + \left(\frac{Q}{1,136}\right)^2 \frac{1}{2g}$		$93.4 + \left(\frac{Q}{1,293}\right)^2 \frac{1}{2g}$

TABLE II. Values of Q Covering Probable Range of Discharge

	$Q =$	10,000	14,000	18,000	22,000	36,000
Section A to Section B:						
$\frac{1}{2g}\left(\frac{Q^2}{1,377^2} - \frac{Q^2}{1,136^2}\right)$	$=$	$\frac{52.8-77.7}{2g}$	$\frac{103-152}{2g}$	$\frac{171-251}{2g}$	$\frac{255-375}{2g}$	$\frac{683-1,005}{2g}$
$426\Delta S_1$	$=$	-0.387	-0.761	-1.242	-1.863	-5.0
S_1	$=$	0.0108	0.00995	0.00883	0.00736	0
n_1	$=$	0.105	0.072	0.053	0.039	
Section B to Section C:						
$\frac{1}{2g}\left(\frac{Q^2}{1,136^2} - \frac{Q^2}{1,293^2}\right)$	$=$	$\frac{77.7-59.8}{2g}$	$\frac{152-117}{2g}$	$\frac{251-194}{2g}$	$\frac{375-289}{2g}$	
$480\Delta S_2$	$=$	0.278	0.543	0.885	1.335	
S_2	$=$	0.01204	0.0126	0.0133	0.01422	
n_2	$=$	0.103	0.075	0.060	0.051	

Plot n_1 against Q on log paper

$$n_1 = \frac{0.445}{\left(\frac{Q}{10,000} + 1\right)^{2.08}}$$

Plot n_2 against Q on log paper

$$n_2 = \frac{0.103}{\left(\frac{Q}{10,000}\right)^{0.91}}$$

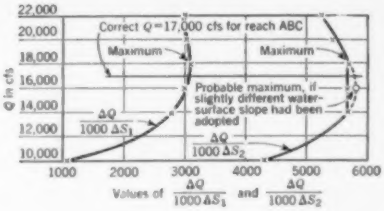


FIG. 2. Curves show required values of Q. More regular curve for reach AB is explained by fact that smaller downstream section at B exercises choking or backwater effect upstream, making water-surface slope just above more turbulent and more difficult to evaluate.

shown the water-surface slope or hydraulic gradient adopted as representative of the flood peak, and in Table I the values of the physical factors computed from field data and applicable to the Manning formula. The last line of the table gives the elevation of the energy gradient at each of the three section points along the reach investigated.

The Manning formula is:

$$Q = \frac{1.486\, AR^{2/3}S^{1/2}}{n}$$

in which

Q = discharge in cfs
A = mean cross-sectional area in sq ft
R = mean hydraulic radius in ft
S = friction slope, or slope of energy gradient
n = coefficient of roughness, or coefficient of channel resistance

Applicable values of $1.486\, AR^{2/3}$ are given in Table I.

Rewriting the formula to $Q = \frac{KS^{1/2}}{n}$, three unknowns are apparent. The procedure of analysis is:

1. To write the values of S and n in terms of Q and substitute in the formula, thus reducing the number of unknown factors to the one factor Q;
2. To apply the principle that stream flow follows the path of least resistance; and
3. To solve for Q.

That part of the reach ABC from Section A to Section B illustrates Case 2, and the slope of the energy gradient will be less than the water-surface slope, since the section area at the downstream section is less than the area at the upstream section and the velocity head at B increases faster than at A with increasing discharge. Indeed, for a discharge of 36,000 cfs, the energy gradient becomes level; of course this is an impossible condition but it serves to indicate that the correct value of discharge would be about one-half, or 18,000 cfs, with a possible 20-percent range either way as determined by past experience with this type of problem.

For reach AB, from Table I,

$$S_1 = \frac{5.0 + \frac{1}{2g}\left[\left(\frac{Q}{1,377}\right)^2 - \left(\frac{Q}{1,136}\right)^2\right]}{426} = S_a + \Delta S_1$$

where S_1 = friction slope

and $S_a = \frac{5.0}{426}$ = water-surface slope

$$Q = \frac{K_1(S_a + \Delta S_1)^{1/2}}{n_1}$$

$$n_1(Q_a + \Delta Q) = K_1(S_a + \Delta S_1)^{1/2}$$

where $K_1 = 10,120$

and Q_a corresponds to S_a.

For reach BC in like manner,

$$S_2 = \frac{5.5 + \frac{1}{2g}\left[\left(\frac{Q}{1,136}\right)^2 - \left(\frac{Q}{1,293}\right)^2\right]}{480} = S_b + \Delta S_2$$

$$Q = \frac{K_2(S_b + \Delta S_2)^{1/2}}{n_2}$$

$$n_2(Q_b + \Delta Q) = K_2(S_b + \Delta S_2)^{1/2}$$

where $K_2 = 9,380$

The reach BC illustrates Case 1, and the slope of the energy gradient will be greater than the water-surface slope. Note that Q has the same value in AB, BC, and throughout the entire reach ABC.

The principle that stream flow follows the path of least resistance, is recognized by stating that the ratio $\Delta Q/\Delta S$ must be a maximum for the channel conditions. For the reach AB, $\Delta Q/\Delta S_1$ must have a maximum value, and for the reach BC, $\Delta Q/\Delta S_2$ must have a maximum value, for the required correct value of Q.

The next step is to set up a tabulation headed by values of Q covering the probable range of discharge, as illustrated in Table II. The corresponding values of friction slope and n are computed and listed. Plotting the values of n against Q on log paper determines the formulas showing variation of n with Q.

The Manning formula is applied to determine the values of Q_a and Q_b corresponding to the values of water-surface slope S_a and S_b, respectively. For the reach AB,

$$S_a = \frac{5.0}{426} = 0.01173; \quad Q_a = \frac{10,120\sqrt{0.01173}}{n_1}$$

$$n_1 = \frac{0.445}{\left(\frac{Q_a}{10,000} + 1\right)^{2.08}}$$

Substituting in the above, $Q_a = 9,000$ cfs

For the reach BC,

$$S_b = \frac{5.5}{480} = 0.01144; \quad Q_b = \frac{9,380\sqrt{0.01144}}{n_2}$$

$$n_2 = \frac{0.103}{\left(\frac{Q_b}{10,000}\right)^{0.91}}$$

Substituting in the above, $Q_b = 7,413$ cfs

The computation for the required value of Q is completed by setting up Table III and plotting Fig. 2. The results can be checked as shown in Fig. 3.

Comparing the results in Table III with Fig. 3, plotted as a check, gives the correct value of Q as 17,000 cfs for the problem conditions. The corresponding values of n are 0.058 and 0.064 respectively, for reaches AB and BC, as interpolated from Table II. In Fig. 2 the more regular curve for reach AB is explained by the fact that the smaller downstream section at B exercises a choking or backwater effect upstream. In Fig. 3 the point where the straight line drawn from its "pole" becomes tangent to the friction-slope curve is the point where the ratio $\Delta Q/\Delta S$ is a maximum for the reach considered, and thus denotes the correct value of Q.

FIG. 3. Curves check values found in Table III. Q_a, S_a, and Q_b, S_b are coordinates of the respective "poles" from which are drawn tangents to the friction-slope curves. Point where straight line drawn from its "pole" becomes tangent to frction-slope curve is point where ratio $\Delta Q/\Delta S$ is maximum for reach considered. This point thus denotes correct value of Q.

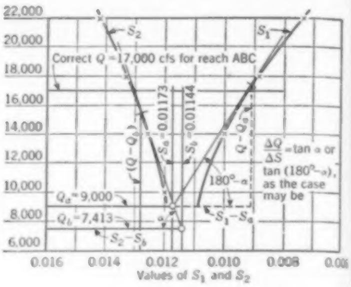


TABLE III. Computations for Required Value of Q

Q =	10,000	14,000	16,000	18,000	20,000	22,000
Section A to Section B:						
ΔQ =	1,000	5,000	7,000	9,000	11,000	13,000
$1{,}000\Delta S_1$ =	0.93	1.78	2.34	2.90	3.63	4.37
$\frac{\Delta Q}{1{,}000\Delta S_1}$ =	1,074	2,810	2,990	3,100 (max.)	3,030	2,970
Section B to Section C:						
ΔQ =	2,587	6,587	8,587	10,587	12,587	14,587
$1{,}000\Delta S_2$ =	0.60	1.16	1.51	1.86	2.32	2.78
$\frac{\Delta Q}{1{,}000\Delta S_2}$ =	4,310	5,680	5,690	5,700 (max.)	5,430	5,250

Notes: $\Delta S_1 = S_a - S_1$ (sign reversed) $= 0.01173 - S_1$ (from Table II)
$\Delta S_2 = S_2 - S_b = S_2 - 0.01144$ (S_2 from Table II)
The coefficient 1,000 is an arbitrary convenience.
$\Delta Q = Q - 9{,}000$ (reach AB), or $Q - 7{,}413$ (reach BC)

Results Evaluated

The accuracy of the conclusions can be no greater than is warranted by the field data. Under flood conditions, the water-surface slope adopted as representative is probably the factor most difficult to determine accurately in the field; this is because of turbulent flow conditions, standing waves, and lack of agreement in elevation of high-water marks established on opposite banks of the stream. A compromise often has to be made to reconcile conflicting data.

The method of analysis here presented can be applied with the minimum of field data, needing only two cross-sections and the connecting water-surface slope. More than the minimum data are desirable. Where several sections are available, with the corresponding continuous water-surface gradient, another method of analysis can be applied with good results, as discussed by the writer in *Engineering News-Record* for August 23, 1934, pages 244 to 246, where the Chezy and Kutter formulas were used to control the analysis.

The method of computing flood discharges based on an assumed value of n for flood conditions, has been considered unreliable for many years and has resulted in many flood-peak records that are inflated 50 percent or more. Recognition of the unreliable character of standard procedure carries with it the burden of devising a better procedure. It is believed that the foregoing considerations will contribute to a more realistic understanding of stream-flow behavior and a better and more accurate treatment of various flood control and flood routing problems.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

About 1,000 ft of 30-in. riveted sheet-metal pipeline was laid on the southwest slope of a mountain to conduct water from a very large seven-stage centrifugal pump to the headgate of a high-line irrigation canal some 300 ft above the river. In the period of a few weeks after the line was assembled and riveted but not yet connected to the pump, the pipeline "crawled" progressively downhill at the rate of 4 or 5 in. a day. When the time came to connect the ends of the line, the upper end had receded several feet from the intake of the canal, and the lower end had by-passed the junction point for the pump connection. The closures were finally made by cutting a piece several feet long off the bottom of the pipe and riveting it to the upper end. Why did the pipe thus "crawl" slowly down the mountain side? For solution, see page 97.

EDITOR'S NOTE: This is the fourth installment of a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that the problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that in its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H.J.G.

Prestressed Concrete in Tampa Bay Toll Bridge

To the Editor: With regard to the 3-mile-long prestressed concrete section of the 15-mile-long toll bridge across Lower Tampa Bay, as described by Maurice N. Quade in the April issue, it seems only natural that Mr. Quade would have a fairly wide range of tests made before adopting the type of prestressed concrete construction I developed, since it will be the first example of importance in the United States. However, its use is no longer new in this country.

The reasons for using prestressed concrete may have been assumed by Mr. Quade to be so obvious as not to need special mention. Apart from reducing the steel required in the beams to less than one-quarter, the prestressed design caused the weight of the beams themselves to be roughly halved. The saving on the supporting structure, in this case trestles, is also of importance, as with 48-ft spans instead of 36-ft, that are 121 fewer trestles. Mr. Quade mentions a net economy of $144,000, and it is not clear whether this takes into account the saving obtained by reducing the number of trestles, or whether this is merely the sum by which the Preload Company's tender was lower than the next alternative.

As to the durability of structures of this type adjacent to or standing in sea water, apart from the advantages of "crackless concrete" mentioned by Mr. Quade, the alloy steel bars of diameters of the order of one inch and the robust end anchorages are, in the event of any untoward exposure, themselves highly resistant to deterioration.

It is, however, the exceptional severity of the tests under alternating stresses to which attention might well be drawn. Because of the very small variations in stress occurring in prestressing steel, when grouted in, the resistance to countless applications of live load is much greater than in the case of ordinary reinforced concrete. For example, ordinary reinforced concrete in bridge beams will often have dead-load plus full live-load stresses in the steel about double those due to dead load alone. With prestressed concrete, assuming fully grouted bars, the change in steel stress at mid-span is only n times the change in the concrete stress immediately adjacent, and in the case of the Tampa Bay bridge, this is only 3,680 psi. The initial prestress in the alloy steel bars is 94,000 psi and assuming, which is most improbable, that the normal calculated loss of 16 percent of this, due to creep and further shrinkage after stressing, does not occur at all prior to application of the full live load, the bar stress at the center of the span will be alternating between 94,000 psi and 97,700 psi. But at the ends there will be no variation whatever.

If the grouting was not effective, and this is most improbable since the bond stress is extremely low, or if the grouting was entirely omitted and there was no friction either, the variation in bar stress at mid-span would be only two thirds of 3,680 psi or, say, 2,400 psi. In that case the end anchorages would be subject to alternations from 94,000 to 96,400 psi, or if full creep and shrinkage had occurred, from 78,000 to 80,400 psi.

The Macalloy steel was developed by McCalls Macalloy Limited and myself specially to meet the particular requirements of prestressing. It was surprising to me, however, that the high-efficiency nuts and the threaded ends did withstand 20,000 and 26,000 cycles of a tensile stress of 79,000 psi alternating up to 102,000 psi. What was so severe was not the high steady stress, of course, but the 23,000-psi rise applied to a bar threading, which normally cannot have any alternation at all. Of course the steel should withstand three million or more alternations of the magnitude that it can be expected to be subjected to, but the magnitude of the alternations that the end anchorages are subject to should be zero. That the threaded ends were not broken at more than 3 million cycles of a steady stress of 97,000 psi, alternating up to 102,000 psi, I understand, fully satisfied both Messrs. Parsons, Brinckerhoff, Hall and McDonald and Mr. Dean, Florida State Bridge Engineer, whose caution in this matter I quite appreciate.

I would only like to add that the efficiency of the end anchorages should average 100 percent of the strength of the plain unthreaded part of the bar, and we do not expect the average of any set of test results to be as low as 96 percent. Further, if the high-efficiency nut is not precisely located on tightening so as to be at the end of the tapering out threading on the bar, the efficiency should be of the order of 92 percent and not 80 percent, which would possibly arise with ordinary nuts and threads. We intended the end anchorage to be the last thing to fail under a test to destruction, and up to now it has been unscathed in all.

Donovan H. Lee, M. ASCE
Consulting Engineer
London, England

Author Replies

To the Editor: Mr. Lee [in the foregoing discussion] questions whether the saving of $144,000 includes the saving resulting from the reduction in the number of trestle bents. It does. The contractor's bid price for the substructure (piles and caps) for the prestressed design is $96,000 less than that for the conventional poured-in-place design. The saving in the superstructure is therefore only $48,000 for a length of trestle of approximately 17,000 ft. Obviously a comparison of costs of two or more designs must be based on the overall total cost of each.

It should be remembered that only the beams are prestressed, and therefore the reductions in the quantities of concrete and steel per lineal foot of superstructure are not large percentagewise. The following comparison, in which A is the conventional design and C the prestressed design, may be of interest:

Item	Design A	Design C
Span length, ft	36	48
Beams, number of	4	6
3,000-psi concrete, cu yd per lin ft	1.55	0.90
5,000-psi concrete in prestressed beams and diaphragms, cu yd per lin ft	None	0.54
Total concrete, cu yd per lin ft	1.55	1.44
18,000-psi reinf. steel, lb per lin ft	350	230
Macalloy bars and anchorages	None	60
Total steel, lb per lin ft	350	290

The primary purpose of the fatigue tests was to establish the fatigue strength of the threaded sections of the bars and the resistance of the threaded anchorages to repeated loading such as that which would occur if the bars are not bonded by grouting after prestressing. The low fatigue strength disclosed by Professor Newmark's tests occurs only in the threaded portions of the bars and is of no significance if the bars are effectively bonded.

It appears that Mr. Lee may rate the efficiency of the nut anchorages in terms of the minimum guaranteed strength of the body of the bar based on nominal diameter. This may be British practice. In this manner, "efficiencies" greater than 100 percent are possible. We prefer to consider the efficiency of the threaded anchorage as the ratio of the load required to break the bar through the threads to the load required to break the unthreaded portion of the same bar.*

M. N. Quade, M. ASCE
Parsons, Brinkerhoff, Hall & Macdonald, Engineers
New York, N.Y.

* In reply to this point Mr. Lee has informed the editor that the "efficiency of the special threading should be 100 percent of the strength of the actual bar and not merely of the minimum guaranteed strength of the bar. Nevertheless, test results of 101 or 102 percent are still possible and are sometimes obtained. Even the slightest, and sometimes invisible, surface defect in the plain bar or bars from the same cast, used as a standard of comparison, is of course sufficient to bring this about."

SOCIETY NEWS

Plan to Attend Centennial Convocation in Chicago, September 3 to 13, 1952

With only three months remaining before the Centennial of Engineering Convocation gets under way in Chicago, members are urged to make final plans for attending what promises to be the most memorable gathering of engineers on record. Increased interest in the Convocation plan, with its dual purpose of explaining the contributions of engineering to our national growth and of providing a program of broad technical appeal, is attested by the fact that the attendance is now estimated at 30,000 instead of the 25,000 originally expected.

To assure suitable accommodations for this large attendance, all desirable hotel space in the city, which is noted for the number and luxury of its hotels, is being reserved for the Convocation period, September 3–13. Those making early reservations, however, will be able to stay at the Conrad Hilton, official ASCE Convention headquarters.

The choice of Chicago as the Centennial Convocation city is particularly appropriate because its phenomenal development in the past one hundred years from a frontier town to the second metropolis of the country and the fourth largest city in the world, is in itself a mighty monument to engineering accomplishment. It was in Chicago that the first skyscraper, the Home Insurance Building, was erected in 1885, and it was in Chicago (in the same building) that first use was made of structural steel, a construction development of such tremendous implication. Chicago, too, was a pioneer in city planning, with emphasis on the development of parks and recreational areas and broad boulevards that give the city of today an effect of spaciousness despite its status as a great railway and distribution center and as the second industrial city of the country. During the Convocation period a day will be given to excursions to such modern engineering projects as the Chicago water works and filtration plants, the Congress Street Expressway, the Wacker Drive Extension, and the city airports.

Members of the Society planning to combine attendance at the Centennial Convocation with a vacation trip for the whole family will find that Chicago, with its extensive and beautiful lake shore development, its 135 parks, and its outlying forest preserves, offers surprising recreational possibilities for a great city. Culturally, it provides such diversions as the Art Institute of Chicago, which has outstanding collections of paintings, prints, ceramics, medieval sculptures, and Oriental art; the Chicago Natural History Museum, noted for its Hall of Babylonian Archeology and for its scientific exhibits;

Centennial of Engineering—Chicago, September 3–13, 1952
Schedule of Sessions of ASCE Technical Divisions

B = Blackstone Hotel, Havana Room
GBH = Grand Ballroom, Hilton Hotel
LS = La Salle Hotel
NBH = North Ballroom, Hilton Hotel
NLH = Normandie Lounge, Hilton Hotel
SBH = South Ballroom, Hilton Hotel
UTH = Upper Tower, Hilton Hotel
WBH = West Ballroom, Hilton Hotel
? = Place not yet known

Date		Air Transport	City Planning	Construction	Eng. Mechanics	Highways	Hydraulics	Irrigation	Power	Sanitary	Soil Mechanics	Structural	100 Years' Progress with Wood	Surv. and Mapping	Waterways	Luncheons, Dinners, Trips
No. of Sessions		2	2	6	4	2	1	2	2	3	4	7	4	2	4	
Wed., Sept. 3	a.m.			LS[5]		LS[5]										Assoc. Gen. Contractors of Am. and Construction Div. Luncheon, LS
	p.m.			LS[1]												
Thurs., Sept. 4	a.m.			LS												
	p.m.			LS												
Fri., Sept. 5	a.m.	B		LS[2]		UTH		LS[2]								Smoker, GBH
	p.m.	B		LS[3]		UTH						LS[3]				
Sat., Sept. 6	a.m.															Inspection trips; Awards Luncheon, GBH; Hon. Members Dinner, GBH
	p.m.															
Sun., Sept. 7	a.m.															Sightseeing excursions
	p.m.															
Mon., Sept. 8	a.m.				UTH					SBH	NLH					
	p.m.				UTH					SBH	NLH	NBH[4]				
Tues., Sept. 9	a.m.				UTH				WBR	SBH	NLH	NBH[6]				Soil Mech. Div. Luncheon; Hydraulics Div. Cocktail Party
	p.m.				UTH		SBH		WBR		NLH	NBH[7]				
Wed., Sept. 10	a.m.							CENTENNIAL DAY								Centennial Luncheon, GBH; Awards Ceremony, afternoon, GBH; Centennial Party, evening
	p.m.															
Thurs., Sept. 11	a.m.		UTH					NLH				NBH[8]	? [9]		WBH	
	p.m.		UTH					NLH				NBH[8]	? [9]		WBH	
Fri., Sept. 12	a.m.											NBH[8]	? [9]	UTH	WBH	
	p.m.											NBH[8]	? [9]	UTH	WBH	

Numerals indicate joint sessions, as follows:
1 Construction Div., Assoc. Gen. Contr. of Am.
2 Construction—Irrigation Divisions
3 Construction—Structural Divisions
4 Structural—Eng. Mechanics Divisions
5 Construction—Highway Divisions
6 Structural Div., Am. Welding Soc.
7 Structural Div., Am. Inst. of Steel Constr.
8 Structural Div., Am. Concrete Inst.
9 Structural Div., Am. Soc. of Mech. Engrs., Am. Soc. for Testing Materials, Am. Ry. Eng. Assoc., Symposium, "100 Years' Progress with Wood"

the Chicago Historical Society, with its internationally famous collection of Lincolniana; and the Adler Planetarium and Astronomical Museum. All these, of course, are in addition to the famous Museum of Science and Industry, where exhibits especially developed for the Centennial celebration are being set up.

Planned entertainment for the ladies includes an extensive sightseeing trip on September 7. For those who look forward to a leisurely opportunity to shop, the Chicago department stores and specialty shops are second to none. Details of the ladies program will be announced later.

A résumé of the time and place of the many Technical Division sessions of ASCE is tabulated on the preceding page. Complete details of these sessions with subject and author of each technical paper will be printed in full in the August CIVIL ENGINEERING. The Society's technical program is being coordinated by G. Donald Kennedy, M. ASCE, assistant to the president of the Portland Cement Association, 33 W. Grand Ave., Chicago. He needs the help of every ASCE member who has a part in formulating the ASCE technical program. Each participant is urged to complete in detail the arrangements assigned to him and clear them with Mr. Kennedy before July 1.

The ASCE part of the program, in addition to Technical Division sessions, will include a Technical Procedure Conference at the Conrad Hilton on September 4 and 5 for discussion of the technical operation of ASCE; a Local Section Conference at the same hotel on September 8 and 9 for 22 mid-continent Sections; and a session for Student Chapter Faculty Advisers.

The breadth and scope of the whole Convocation program naturally entail a tremendous amount of work, particularly in developing and coordinating the many hundreds of technical sessions and other functions involved in the meetings of no less than 55 other engineering organizations meeting in Chicago during the period September 3–13. The societies participating in the Convocation are named in the accompanying tabulation, which shows the place and date of the meetings. Each society has full responsibility for arranging its own meeting, subject to general coordination under the overall supervision of a Convocation Committee of the Board of Directors of the Centennial Corporation. This great task rests in the hands of two committees composed of representatives of each of the participating societies. One is the Committee on General Arrangements under the chairmanship of Howard F. Peckworth, M. ASCE, managing director, the American Concrete Pipe Association, 228 N. La Salle Street, Chicago. The other is the Coordinating Committee on Technical Programs under the chairmanship of G. Donald Kennedy.

Under the direction of E. Lawrence Chandler, twelve overall symposiums of general interest are scheduled for the September 3–13 period. The subjects, chairmen and meeting places of the symposium sessions are shown in an accompanying tabulation. Titles of papers and their authors are nearly ready for release.

All engineers and their friends, whether members of the participating societies or not, are welcome to attend all symposium sessions, pageants and exhibits.

Other details of the Centennial Convocation are to be found in the following recent issues of CIVIL ENGINEERING: January, pages 108 and 109; February, page 65; March, pages 58 and 59; April, pages 61 and 65; May, pages 69 and 71.

Schedule of Symposium Programs

Symposium	Location	Dates Sept.
Professional Societies	8th St. Theater	3
Education and Training	8th St. Theater	4
Food	Palmer House, Red Lacquer Room	5
Tools	8th St. Theater	5
Transportation	Conrad Hilton Ballroom	8, 9
Mineral Industries	Sherman Ballroom	8, 9
Structures and Construction	8th St. Theater	8
Chemical Industries	8th St. Theater	9
Communications	8th St. Theater	11, 12
Energy	Conrad Hilton Ballroom	11, 12
Health	La Salle Ballroom	11
Urbanization	La Salle Ballroom	12

Organizations Meeting at Centennial of Engineering, Chicago, 1952

Organization	Headquarters	Sept. '52
Am. Assn. of Engrs.	Lake Shore Club	3
Am. Assn. for Adv. of Science	Ill. Inst. of Tech	4
Am. Chem. Soc. (Chicago Sect.)	Coliseum	9–13 incl.
Am. Concrete Inst.	Conrad Hilton	11, 12
Am. Geophysical Union	Del Prado & Conrad Hilton	11, 12
Am. Inst. of Architects	Museum of Sci. & Ind.	8
Am. Inst. of Chem. Engrs	Palmer House	10–13 incl.
Am. Inst. of Consulting Engrs	University Club	8
Am. Inst. of Elec. Engrs	Congress	10, 11, 12
Am. Inst. of Mining & Met. Engrs.	Palmer House	3–7 incl.
Am. Iron & Steel Inst.	Palmer House	11
Am. Meterological Soc.	Del Prado & Conrad Hilton	11, 12
Am. Power Conf. (Spons. by Mid-West Power Conf.)	University Club	4
Am. Public Health Assn. (Eng. Sect.)	....	..
Am. Railway Engr. Assn.	Palmer House	8, 9, 10
Am. Rocket Society	Sheraton	..
Am. Soc. for Eng. Educ.	W. Soc. Engrs. Hdqs., Sheraton	3, 4, 5
Am. Soc. for Agr. Engrs	La Salle	8, 9
Am. Soc. of Civil Engrs	Conrad Hilton	3–13 incl.
Am. Soc. of Lubrication Engrs	Sherman	8, 9, 10
Am. Soc. of Mech. Engrs.	Sheraton	8–11 incl.
Am. Soc. of Safety Engrs.	La Salle	5
Am. Soc. for Test. Mat.	Sherman	10, 11
Am. Soc. of Tool Engrs	....	9
Am. Standards Assn.	Museum of Sci. & Ind.	8, 9, 10
Am. Welding Soc.	Jointly with other societies	..
Armour Research Found.	....	..
Assn. of Consulting Engrs	Sheraton	5
Boston Soc. of Civil Engrs	....	9
Chi Epsilon Fraternity	Ill. Inst. of Tech.	12, 13
Chicago Tech. Council	W. Soc. Engrs. Hdqs.	11
Council of Eng. Soc. Secretaries	Sheraton	11, 12
Engrs. Council for Prof. Development	Sheraton	5, 6
Eng. Inst. of Canada	Conrad Hilton	5
Ill. Eng. Council	....	6
Ill. Soc. of Prof. Engrs	Sherman	5
Illuminating Eng. Soc.	Edgewater Beach Hotel	8–11 incl.
Industrial Man. Soc.	....	11
Inst. of Radio Engrs.	....	12
Inst. of Traffic Engrs	Sherman	8–11 incl.
Int. Commission on Irrig. & Drainage	Conrad Hilton	8
Int. Commission on Large Dams	Conrad Hilton	5
M.I.T. Club of Chicago	....	9
Natl. Conf. on Ind. Hydraulics	Sherman	4, 5
Natl. Council of State Bds. of Eng. Exam.	Conrad Hilton	9–12 incl.
Natl. Soc. of Prof. Engrs	Sherman	5, 6
Soc. for Adv. of Mgment.	Ill. Inst. of Tech.	11, 12
Soc. of Amer. Military Engrs	Conrad Hilton	13
Soc. of Automotive Engrs	Knickerbocker	4
Soc. of Naval Arch. & Marine Engrs.	Sherman	5, 6
Soc. of Women Engrs	W. Soc. Engrs. Hdqs.	5, 6
Western Soc. of Engrs	W. Soc. Engrs. Hdqs.	4
World Power Conf.	Drake	4

Colorado Section Completes Denver Convention Program

With only a short time remaining before the ASCE Denver Convention, June 16–20, gets under way, the energetic Convention committees of Colorado Section members are leaving no stone unturned to assure that visiting engineers and their families will have the maximum of enjoyment. The period June 16 through 20th will be proclaimed Civil Engineering Week by Mayor Quigg Newton of Denver as a gesture toward "recognition of the engineer in modern living." The mayor's proclamation will further increase public awareness of the Convention and of the contributions of engineering to our civilization.

Under the direction of General Chairman Alfred J. Ryan, special attention is being given to making the Convention a vacation treat for the entire family as well as professionally stimulating for the delegates. To make it a real vacation for all, special thought has been given to keeping the small fry happy and out of trouble. Baby sitters will be available at any time for small children, and suitable companions and entertainment will be provided for older children. With the children taken care of, the ladies of the party will be able to avail themselves of the entertainment planned—a trip to the colorful old gold-mining town of Central City, with a visit to the old stone opera house and a rehearsal of one of the 1952 operas; a ladies' coffee hour at the Cosmopolitan Hotel; and a luncheon and social hour at the luxurious Lakewood Country Club.

At left huge siphon carries waters of Colorado-Big Thompson Project's Horsetooth Feeder Canal across Big-Thompson River and the highway to Estes Park. The rugged ramparts of the Rockies will form spectacular backdrop for Denver Convention. View below is seen from Trail Ridge Road in Rocky Mountain National Park.

To provide maximum opportunity for visitors to feast their eyes on outstanding mountain scenery, while inspecting famous engineering projects, three week-end field trips have been charted. One will take Convention visitors over Denver's new Valley Highway, the Denver-Boulder Turnpike, and the new Clear Creek Canyon highway with its several tunnels. Central City is also included in the itinerary. The two most outstanding trips, however, will permit delegates to inspect the mammoth Colorado-Big Thompson project, which carries water from the headwaters of the Colorado to the rich agricultural lands east of the Continental Divide. A two-day trip will cover engineering and scenic attractions on both sides of the Continental Divide. A one-day trip will inspect only the features of the Colorado-Big Thompson project east of the Divide. The many other interesting trips planned for Denver Convention week and the exceptionally diverse schedule of technical sessions are listed in the Convention program, which was printed in the May issue.

To make longer stays in Colorado feasible, the Convention committee will make arrangements for reservations at guest ranches, resorts, and hotels. Unexcelled fishing and hunting, miles of fine mountain highways, and the unsurpassed beauty of the Rockies are some of the attractions offered. Those desirous of having the latest information on Convention plans and accommodations should get in touch with the Convention Chairman, Denver Convention and Visitors Bureau, 225 West Colfax, Denver, Colo.

Benjamin Fairless Wins 1953 John Fritz Medal

Benjamin F. Fairless, M. ASCE, president of the United States Steel Corporation, has been awarded the 1953 John Fritz Medal and Certificate as "Champion of the American free enterprise system for notable industrial achievement in the production of steel." Established in 1902 by friends of John Fritz to honor him for his contributions to the manufacture of steel,

the medal is perpetuated by the four Founder Societies as "a joint honor for scientific or industrial achievement in any field of pure or applied science."

Benjamin F. Fairless

The award to Mr. Fairless is the culmination of a long series of honors that have come to him for his achievement and leadership in the production of steel. A civil engineering graduate of Ohio Northern University in 1913, Mr. Fairless had some technical experience before going into the steel business. He worked up from mill superintendent for Central Alloy Steel to president of the Carnegie-Illinois Steel Corporation in 1935 and president of the U. S. Steel Corporation in 1938.

Presentation of the John Fritz Medal to Mr. Fairless will be made during the ASCE Centennial of Engineering Convocation in Chicago in September.

DeForest A. Matteson, Jr., Joins Publication Staff

Editorial work for the Society's technical publications, particularly the Proceedings Separates, has been materially strengthened by the addition of DeForest A. Matteson, Jr., J.M. ASCE, of Pittsburgh, Pa., as an assistant technical editor. He assumed his new duties in the middle of May.

DeForest Matteson

Completing his undergraduate work after nearly three years in the Army, Mr. Matteson received an A.B. degree from Allegheny College, with majors in pre-engineering and English. His professional studies were pursued at Carnegie Institute of Technology, where he earned a B.S. in Civil Engineering in 1949. Since then he has accumulated almost enough credits for his M.S. degree. In practical professional work, Mr. Matteson has served briefly on highway construction in New York State and bridge engineering, both design and fabrication, in Pittsburgh. His latest assignment was as technical trainee with the Bethlehem Steel Co. in Pittsburgh, Pa.

Executive Committee Actions at San Diego Briefed

Meeting in San Diego, Calif., on May 2, 1952, during the Fifth Annual California Conference of Local Sections, the Executive Committee of the Board of Direction took the following action:

Five Research Projects Continued

Several research projects, sponsored by ASCE and now under way, were recommended for Engineering Foundation grants-in-aid for another year. The recommended projects are: Riveted and Bolted Structural Joints; Reinforced Concrete; Causes and Methods of Prevention of Corrosion in Pipes; Columns; and Waves. This action was taken following a report of the Society's Committee on Research (A. E. Cummings, chairman), requesting that the projects be continued and the Engineering Foundation be asked for a total of $7,000 to support the studies.

Engineering-Mechanics Division

A meeting of the Executive Committee of the Engineering-Mechanics Division, scheduled for Chicago during the present fiscal year, was authorized.

Technical Division Structure

J. M. Garrelts, chairman of the Committee on Study of Technical Division Structure, presented the preliminary recommendations of that committee. The report recommends that existing Technical Divisions be strengthened to meet a certain performance standard to justify their continuance as Divisions, and that new Divisions be established only on substantial evidence that they will be active. ASCE operates in two distinct fields of interest—the technical field, and the field of conditions of practice. The report recommends that these two activities be organized into two parallel stems. The first stem would lead from the Committee on Division Activities, through the Technical Procedure Committee (TPC), to the Technical Divisions. The second stem, concerned with conditions of practice, would lead from the Board of Direction's Committee on Coordination of Professional Activities through a proposed new Committee on Conditions of Practice parallel to TPC, to the present professional committees of the Society. The new committee would include Board members and representatives from all professional committees as well as the committees on Local Sections, Junior Members, and Student Chapters.

The Executive Committee requested the Task Committee to make further studies of the Society's committee structure both within and outside the limitations of the Constitution, and rejected petitions to form a Division on Management and a Division on Professional Practice.

Local Section Conference During Centennial Convention

On request of the Committee on Local Sections, a two-day Local Section Conference was approved, to be held in Chicago between September 3 and 13 and to include the following 22 Local Sections: Akron, Central Ohio, Central Illinois, Cincinnati, Cleveland, Dayton, Duluth, Illinois, Indiana, Iowa, Kentucky, Michigan, Mid-Missouri, Nashville, Northwestern, St. Louis, Toledo, Tri-City, Wisconsin, Tennessee Valley, West Virginia, and Pittsburgh.

San Francisco Convention Expanded to Include Hawaii

The San Francisco Convention is scheduled for March 2–7, 1953. On request of committees of both the San Francisco and Hawaii Sections, approval was given to inclusion of a convention program in Honolulu about a week after the San Francisco program.

Centennial Commemorative Stamp

After examining the three designs for the proposed Centennial commemorative stamp prepared by the Post Office Department, a design featuring an old covered bridge, a modern suspension bridge and the ASCE shield was favored. Past-President Hathaway was given power to speak for the Society in reaching final conclusions with postal officials.

Several first-day cover designs were reviewed by the Committee. Detailed arrangements for handling the sale of first-day covers were referred to the Executive Secretary with power. Details will be published in the July issue.

Delegates to UPADI Convention Named

President Proctor and Past-President Hathaway were named delegates to represent ASCE on the EJC delegation to the UPADI Convention, to be held in New Orleans, La., August 26–30, 1952.

CIVIL ENGINEERING Centennial Issue

An enlarged Centennial (September) issue of Civil Engineering was approved by providing appropriate changes in the current budget. The Centennial issue is envisaged as containing articles based on papers to be presented during the Centennial Convocation in Chicago before Technical Division sessions. It is to be available during the Convention. After considering a memorandum on the general

subject of Civil Engineering, the Executive Committee expressed the opinion that budgetary provision should be made for more coverage of the internal affairs of the Society.

Engineer-Architect Contracts with Prime Contractors on Defense Projects

On certain types of defense construction, prime contractors are required to employ acceptable engineering firms for services called for as part of the construction contracts. It was reported that such engineering services are being solicited and awarded by prime contractors solely on the basis of price. The question of disciplinary action by the Society to be applied to members of the Society who submit bids for obtaining work in this manner solely on a price basis was referred to the Committee on Private Engineering Practice.

Matilda Steinbrenner, Former Employee, Dies

Miss Matilda Steinbrenner, long-time Society employee, who since her retirement has been living at her home in Williamsport, Pa., died there on May 18.

Following graduation from Pratt Institute Library School and training in library work, Miss Steinbrenner came to the Society in December 1899. She left in January 1939 after almost 40 years of service. She was style editor for technical publications, including Proceedings, Transactions, and Manuals. The whole period of her work for the Society was one of great publication activity, when Society affairs, minutes of all meetings, additions to the library, and many similar details were included in the monthly Proceedings. Hers was a prodigious job which for much of the time she handled alone, with the painstaking attention to detail that gave these publications unusual accuracy, and a continuous persistence that brought them out always on time.

Quantity lots of ASCE Manual No. 29 may now be obtained from Society headquarters at reduced rates. As currently printed and bound, this manual of professional practice is now available in lots of ten at 40 cents each, and in lots of 25 or more at 30 cents each, prepaid. Single copies are 50 cents. Recently issued by the ASCE Committee on Private Engineering Practice (March issue, page 57), Manual No. 29 covers professional fees.

Engineers Meet with U.S. Civil Service Commission

Attacking recruiting problems at recent meeting in Washington of U. S. Civil Service Commission with recently created Advisory Committee on Engineering in Government are, left to right, Leslie N. McClellan, M. ASCE, chief engineer, U.S. Bureau of Reclamation, Denver; James D. Forrester, chairman, Department of Mining Engineering, Missouri School of Mines and Metallurgy; Ross Pollock, chief, Examining Program and Standards Branch of the Commission; James M. Mitchell, civil-service commissioner; Ernest J. Stocking, M. ASCE, chief, Washington Recruiting Branch of the Commission; Joseph H. Ehlers, M. ASCE, field representative, ASCE; and Blake R. Van Leer, president, Georgia Institute of Technology. Members not pictured are Edwin O. Griffenhagen of Griffenhagen and Associates, management engineers, Chicago, and ASCE Past-President Ezra B. Whitman, of Whitman, Requardt and Associates, consulting engineers, Baltimore.

Local Sections Sponsor Large Spring Conferences

Recent large-scale Local Section conferences in all parts of the country have provided opportunities for group discussion of Society affairs at local level and for study and inspection of new engineering works. Reports of highly successful meetings have already been received from the well-established California and Pacific-Northwest Conferences and from the First Annual Convention of District 9.

California Conference

About 350 members and students attended the Fifth Annual Conference of California Sections, to which the San Diego Section was host May 1–3. The agenda included a meeting of the Executive Committee of the Board of Direction, which is abstracted elsewhere in this issue.

During the program the responsibility of the engineer in modern-day living, both in the scientific and political field, was enthusiastically discussed under the leadership of ASCE President Carlton S. Proctor and F. T. Letchfield, of San Francisco. Other leading papers included the President's Water Policy Commission in its application to California reported by W. G. Sloan, A.M. ASCE, co-author of the Pick-Sloan Plan for development of the Missouri River Basin; "Basic Concepts of Prestressed Concrete," discussed by George Youngclaus, of the Portland Cement Association; and the requirements of California's electric power program, which were outlined by H. A. Lott, chairman of the Pacific Southwest Power Interchange Committee.

The technical program was supplemented by trips to the Miramar Naval Auxiliary Air Station, the Silver Gate Steam Electric Plant, and the Alvarado Water Filtration Plant. There were also trips for the visiting ladies—to the La Jolla shopping center, the Scripps Institute of Oceanography, and the famous San Diego Zoo.

In a series of resolutions passed by the group, it was decided to combine the Sixth Annual Conference with the ASCE San Francisco Convention, to be held March 4–6, 1953, and to ask the Society to determine how far both Local Section and Society needs for expanded service could be met by an annual dues increase of \$5, \$7.50, or \$10. The Conference also decided to explore the feasibility of expanding to include all Local Sections in District 11 in the Conference organization.

Especially gratifying was the large attendance of students, representing Chapters at the University of Arizona, the University of Southern California, both the Berkeley and Los Angeles campuses of the University of California, the University of Nevada, Stanford University, Santa Clara University, the University of New Mexico, and California Institute of Technology. Details of the student program which constituted an important part of the meeting, will be given in the July issue in connection with reports of other regional student conferences.

Pacific Northwest Conference

A symposium on engineering aspects of atomic energy was featured in the technical program presented at the Pacific Northwest Conference, held in Richland, Wash., May 15–17, under sponsorship of the Columbia Section. Moderated by James E. Travis, conference vice-chairman, the symposium included papers by D. G. Sturges, of the Atomic Energy Commission, and C. P. Cabell, W. E. Johnson, H. S. Davis, and D. W. McLenegan, of the General Electric Co. Supplementary talks in the field were given by D. F. Shaw, manager of the Hanford Operation Office, and G. R. Prout, vice-president and general manager of General Electric, who spoke at the men's luncheon, and Dr. H. M. Parker, of General Electric, who discussed "Radiation Hazards and the Engineer" at the dinner meeting.

A technical symposium on the McNary Project, with B. Loyal Smith as moderator and Corps of Engineers personnel as speakers, was followed by inspection of the levees from Richland to Pasco. The party then boarded a barge for a trip from Pasco down the Columbia River to McNary Dam, which proved to be one of the highlights of the Conference. At McNary Dam the barge went through the lock and across the tailwater below the dam, where river flow in excess of 400,000 cfs produced an impressive spectacle. The trip through the powerhouse now under construction, led by S. G. Neff, and J. R. Thatcher, of the Corps of Engineers, provided a view of the reinforcing and form work for the penstock and scroll case construction.

The Ladies' Auxiliary provided an interesting program for wives of members attending the conference. The program included an extensive tour of the Richland area and a luncheon at which members of the visiting auxiliaries pooled their organizational experiences for their mutual benefit. The conference came to a close with a chuck wagon dinner at the Richland Riding Academy. Beef barbecued over a charcoal fire was served in true Western style, complete with Western orchestra, and other accessories.

Conference officials and Columbia Section officers are photographed at Pacific Northwest Conference in Richland, Wash. In front row, left to right, are E. E. Gerrick, president, of Columbia Section and conference director; Roy L. Greene, president, Tacoma Section and director; James E. Travis, conference vice-chairman; E. C. Dohm, ASCE Director, District 12; Guy H. Taylor, conference chairman; H. Loren Thompson, conference secretary-treasurer; and Prof. E. B. Moore, president, Spokane Section and director. In second row, same order, are M. B. Nelson, first vice-president, Columbia Section; Wayne I. Travis, president, Southern Idaho Section and director; Elmo Sims, secretary-treasurer, Columbia Section; L. E. Rydell, second vice-president, Columbia Section; G. C. Richardson, director, Columbia Section; George C. Aug, director and past-president, Columbia Section; and H. E. Struck, director, Columbia Section. Officials not shown in picture were R. T. Hurdle, president, Montana Section and director; Cecil C. Arnold, president, Seattle Section and director; and Thomas Smithson, president, Oregon Section and director.

The newly elected officers to serve through the 1953 conference meeting in Seattle next spring are: James E. Travis, chairman; Byron J. Clark, vice-chairman; and M. B. Nelson, secretary-treasurer.

District 9 Convention

More than 100 members and their families attended the First Annual Convention of District 9, held in Dayton, Ohio, on April 18 and 19. The Dayton Section under the direction of its president and convention chairman, C. Russell Dole, served as host Section. Featured speakers included ASCE Vice-President Daniel V. Terrell, who addressed the opening luncheon on the critical shortage of engineers, and President Carlton S. Proctor, who reviewed a century of engineered progress at the evening banquet. Colonel Proctor's talk emphasized the challenges facing the profession and suggested ways of meeting its inherent responsibilities.

Of special interest also was a Civic and Professional Responsibility Forum. Speakers were Wayne Hopkins, scout executive for the Miami Valley Council of the Boy Scouts of America, who discussed engineers' opportunities in civic affairs, and Herbert Starick, city manager of Middletown, Ohio, whose subject was "Good Government Is Your Business." ASCE Director G. Brooks Earnest reported on the recent New Orleans Convention to the session, and also outlined plans for the Centennial of Engineering Convocation in Chicago in September.

Inspection trips had been arranged to a number of points of local interest, including the Dayton Water Treatment Plant, the O. H. Hutchings Power Station of the Dayton Power and Light Co., and a concrete pipe plant. There was also a tour of the Miami Conservancy District. Discussion of the latter project by Barton Jones, chief engineer of the Miami Conservancy District, comprised the program at one of the luncheon meetings.

Snow, Ice and Permafrost Index in E. S. Library

A rapidly growing file of references and abstracts on snow, ice and permafrost is available in the Engineering Societies Library. Already references to 1,800 articles, books and reports are indexed by author or sponsoring organization, and by subject. A few of the subjects covered include air temperature, anchor ice, frost action on concrete, construction in permafrost regions, formation of frazil ice, glaciers, reflectivity of ground covers, and water supply.

The bibliography is being prepared by the Library of Congress under a contract with the Army Corps of Engineers. The entire file may be examined in the Engineering Societies Library. Requests from ASCE members who cannot visit the Library will be answered by mail or telephone.

Philadelphia Section Celebrates Centennial of Engineering

ASCE Director Francis S. Friel (left) discusses Centennial celebration program with former Society Vice-Presidents William R. Glidden (center) and Henry J. Sherman.

Dr. James Creese (left), president of Drexel Institute of Technology and keynote speaker, is introduced to assemblage attending Philadelphia Section Centennial celebration by Samuel S. Baxter, Section president and master of ceremonies.

A large Philadelphia Section celebration of the founding of the American Society of Civil Engineers in 1852 took place at the Bellevue-Stratford Hotel in Philadelphia during the afternoon and evening of May 19. The keynote address was delivered by Dr. James Creese, president of Drexel Institute, who said the primary objective of engineering education is the making of human beings—not automatons.

For the afternoon session the engineers separated into four panel discussion groups. One panel took up the subject of educating engineers for the future; another the advances made in the past century in the construction of buildings and highways, and the development of labor-saving equipment with which these advances were accomplished; and another the progress in electric power, transportation, communication and industry. An all-star cast led the engineering panel—ASCE President Carlton Proctor and Past-Presidents Whitman, Dougherty, Howard and Hathaway. These experts presented the past record, present status, and a guess as to future developments in the fields of foundations and soil mechanics, sanitary engineering, railroads, toll roads and bridges, and the civil works of the Corps of Engineers.

After dinner Dr. Roger Marshall, astronomer and director of radio and television educational programs, fascinated an audience of 400 engineers and their lady guests with an explanation of the universe in which we live.

In the principal address of the evening, President Proctor spoke on the Centennial of Engineering Convocation, to be held in Chicago during the period, September 3–13, as the culminating feature of Centennial celebrations being held in cities throughout the United States.

Four ASCE Past-Presidents and current President Carlton S. Proctor gather in Philadelphia for Section celebration of Centennial of Engineering. Shown, left to right, are Past-Presidents Ezra B. Whitman and Richard E. Dougherty, President Proctor, and Past-Presidents Ernest E. Howard and Gail A. Hathaway.

Can You Help the Structural Division?

ERNEST C. HARTMANN, M. ASCE Chairman of Committee on Promotion of Member Participation in Technical Activities, Structural Division, ASCE

This article completes a series describing the work of the eleven technical committees of the Structural Division briefly outlined by the committee chairmen. Their reports are proof of accomplishment by the technical committees. The other articles in the series appeared in CIVIL ENGINEERING for March (page 57) and April (page 62).

The purpose of this new venture can best be described by a statement of J. M. Garrelts, Chairman of the Executive Committee of the Structural Division: ". . . . . the future welfare of technical activities of ASCE depends on making it possible for every member of the Society to take part in these technical activities. . . ."

Those members who have found these reports interesting are again invited to take part. Send a postal card to the writer at P. O. Box 772, New Kensington, Pa.

In the near future, this Committee expects to report the results of our new venture in interesting more members in the work of the Division.

Committee on Timber Structures

This committee of which Howard J. Hansen is chairman, was organized in 1942 with the primary purpose of correlating test data with the design of timber structures especially in regard to the detail of connections. Since that time its activities have encompassed all fields of timber design and construction.

The first undertaking of the committee was the compilation of a classified bibliography on the physical and mechanical properties of wood and the design and construction of timber structures. This bibliography was published in Proceedings for March, 1944. Since that time the bibliography has been kept up to date. A new bibliography will be presented for publication in the next few years.

The committee has reviewed many papers for publication and has assisted the executive committee of the Division in arranging programs for technical sessions. At the Fall Meeting in October 1947, in Jacksonville, Fla., this committee arranged for two sessions of the Division. These sessions were devoted to a symposium on structural timber and included papers on every phase of timber

(*Continued on page 67*)

design and construction. Many of the papers were published later by ASCE.

For the past several years the committee has been devoting the majority of its time to rewriting Manual No. 17, "Timber Piles and Construction Timber." The final manual will include sections on all phases of timber design and construction. Subcommittees to prepare each section have been appointed. Many subcommitteemen are not members of the Committee on Timber Structures or of ASCE.

At present the committee is preparing a program for two sessions at the Centennial of Engineering under the general theme of "One Hundred Years of Progress in Wood."

When the committee was first organized nine members were appointed. At present there are 24 members. The committee chairman as well as the committee members welcome new members who are strongly interested in contributing to the knowledge of this important civil engineering field.

Committee on Bridge Loadings

This committee, of which T. Y. Lin is chairman, is attacking an unsolved problem in bridge design, that is, the stress in bridge members which can be produced by actual vehicle loads, both present and future. In an effort to aim at a logical provision for these loads, the committee has set up as its purpose: (1) to study stresses produced in bridges by highway vehicle loads and (2) to study the relation between loads and the other factors affecting the economic design of bridges.

It is known that while bridges are designed for certain specified hypothetical loadings and highway vehicles are limited by certain legal requirements, the actual loads often exceed both of them. As an initial step toward evaluating the effect of actual loads, stresses produced by various heavy highway vehicles including military loads have been investigated. This has involved survey and computation for single vehicles as well as for successions of them. A limited amount of study has been given to the frequency of heavy loadings and the effect on service life. A selected bibliography on bridge loadings has been compiled.

Experimentally, the problem is being attacked by starting a series of stress measurements produced by design vehicle loads and by overloads. The experiments were carried out in Michigan on the Fennville Bridge and in California on the San Leandro Creek and Arroyo Seco bridges.

Members can participate by keeping the committee informed of any heavy loads throughout the country, especially

(*Continued on page 70*)

Georgia Section Has Centennial Celebration

Speakers' table at recent Centennial of Engineering Dinner held by Georgia Section at the Ansley Hotel in Atlanta shows (left to right) Moses E. Cox, general chairman and immediate past-president of Section; ASCE Director James Higgs; Society President Carlton S. Proctor; Section President Warren S. Mann; and Burton J. Bell, secretary-treasurer of Section and editor of "Civil Engineering in Georgia." With record attendance of 529, the occasion also celebrated the 40th birthday of the Georgia Section, second oldest in the Society. In the major address of the evening, Colonel Proctor congratulated the profession on its century of contributions to the development of the nation, saying this age belongs to the engineers as much as to any other body of men, but warned against the danger of complacency. He urged that "the country's 400,000 engineers take the lead in an aggressive program to fight statism."

New Contributors to Centennial Financing Listed

Contributions toward financing the Centennial program received as of March 13 by Centennial of Engineering, 1952, the corporation formed to direct overall phases of the project, were listed in the April issue (page 65). Additional contributions to the financing fund, received up to May 22, are announced by Frank W. Edwards, general manager of the Centennial, and listed here.

George S. Armstrong & Company
Harland Bartholomew & Associates
Detroit Edison Company
Edwards, Kelcey & Beck
General Electric
Gibbs & Hill

Great Northern Railway Company
Hazelet & Erdal
Horner & Shifrin
International Harvester Company
Joy Manufacturing Company
Lukens Steel Company

Material Service Corporation
Moran, Proctor, Freeman & Mueser
Portland Cement Association
Pullman Standard Car Mfg. Co.
Sanderson & Porter

F. W. Scheidenhelm
Stone & Webster Engineering Corp.
Sverdrup & Parcel, Inc.
United States Potash Co.
General American Transportation Corp.
Barber-Colman Co.

Caterpillar Tractor Co.
DeLeuw, Cather & Co.
Forrest & Cotton
Knappen-Tippetts-Abbett-McCarthy
Modjeski & Masters
Rockwell Mfg. Co.

Singstad & Baillie
Standard Oil (New Jersey)
Stevens & Thompson (Engineers)
Charles H. Tompkins Co.
Whitman, Requardt & Associates

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE

Field Representative ASCE

An old Chinese proverb says, "The journey of a thousand miles begins with a single step." Two carefully planned steps were taken during May which mark milestones in the progress of the Society, and we hope mark only the beginnings of a new era of needed cooperative action.

ASCE–AIA Joint Cooperative Committee

On May 9 the newly organized Joint Cooperative Committee of ASCE and the American Institute of Architects held its organizing meeting. It is appropriate that in this our centennial year the architects, who were included in the original Society in 1852 and who formed a separate organization five years later, should join in a cooperative committee to reassert the original unity of the technical design professions. The ASCE contingent on the new committee consists of Craig Hazelet of Louisville, co-chairman, ASCE Director Brooks Earnest of Cleveland, Mason Lockwood of Houston, with the Field Representative serving as co-secretary. The prevailing query at the first meeting was why such an obvious association of interests had not been effected long ago. Subjects considered included exchange of information on prospective legislation, civil defense, construction controls, cooperation in universities, action relating to the Supreme Court decision in the Wunderlich case. Several matters involving disputes between engineers and architects were touched upon. If the two leading technical design professional societies which actively deal in governmental matters agree on common objectives, a bright future is in store.

Committee Advises Civil Service Commission

The Advisory Committee on Engineering to the U. S. Civil Service Commission held its initial meeting and discussed some urgent and far-reaching problems relating to engineering personnel, including salaries, recruiting, cooperative summer work for students, examination procedures and basic policies. Such a committee was suggested in 1939, but its establishment never proved feasible. Several years ago at the suggestion of the ASCE Board of Direction, Engineers Joint Council set up a committee to foster the idea further and was successful in its objective. The Advisory Committee representing the engineering profession which met with Civil Service Commissioner Mitchell and department heads numbers among its members the president of an important engineering college, the senior past-president of ASCE, the chief engineer of a leading government agency and the head of a leading management engineering firm. [See photo elsewhere in this issue.] The obviously important objective is to place advice from representative members of the engineering profession at the disposal of the U. S. Civil Service Commission. At present it is the only Advisory Committee serving the Commission, and will hence be important in determining the place of technical advisers in general in the Commission's operations. This development demonstrates the growing interest of the Society in the welfare and the problems of the large and increasing proportion of our members under Civil Service.

Other Washington Meetings of Interest

Several more meetings deserve mention. At the annual meeting of the U. S. Chamber of Commerce at which such matters as economic controls, materials limitations and the steel strike were thoroughly aired, one afternoon was devoted to a round-table discussion on "Who Should Develop Our Water Resources?" Several members of ASCE and of the EJC Water Policy Committee took an active part and many others attended this lively and crowded session. The question of national water policy is thus becoming a prominent national issue and one in which the voice of the engineer will be heard.

Henry Fowler, Administrator of DPA and NPA met on May 15 with the Construction Mobilization Committee of the U. S. Chamber of Commerce, of which ASCE President Proctor is a member. The Administrator assured the committee that NPA controls are gradually being liberalized. The prohibition on the use of controlled materials for recreational construction will be removed, effective July 1, and self-authorization of five tons of steel, as well as some copper and aluminum, will be permitted. Effective October 1, general commercial construction will be permitted 25 tons of steel including as much structural steel as needed, 750 lb of copper and 1,000 lb of aluminum through self-certification. Some materials are being decontrolled and certain types of structures are being changed from commercial to the more liberal industrial category. The general policy seems to be to keep the framework of controls so that they could be quickly stiffened in an emergency but to be liberal in permitting whatever increases in the use of critical materials the improving supply situation warrants.

ASCE MEMBERSHIP AS OF MAY 9, 1952

Members	8,093
Associate Members	10,299
Junior Members	16,156
Affiliates	68
Honorary Members	37
Total	34,653
(May 9, 1951	32,242)

Legislation

EJC has submitted a statement to the House Banking Committee in support of bills which would permit professional and other self-employed workers to exclude from taxable income in any year the amounts used to purchase an annuity contract. Possibility of passage this session is not considered likely.

During the month representatives of EJC testified at length before a Special Subcommittees on Public Works on National Water Policy.

A proposed Federal Construction Contract Act of 1952 (S. 2907) would require the naming of subcontractors in bids on federal construction and the award of separate contracts for mechanical specialty contractors in certain cases.

Miscellaneous

The Housing and Home Finance Agency as a participant in the Point IV Program contemplates work requiring the services of some architectural, structural and sanitary engineers and is now establishing a preliminary panel of candidates. Engineers interested in such work should communicate with the Employment Office, Housing and Home Finance Agency, 1626 K Street, N.W., Washington, D.C.

The Renegotiation Board has issued a handbook "Renegotiation Board Regulations." This may be obtained from the Government Printing Office for $1.50, which includes revisions to be issued during the year. The Board is planning to set up regional offices in Boston, New York, Washington, Detroit, Chicago and Los Angeles for the conduct of actual renegotiation proceedings.

Washington, D.C.
May 20, 1952

Successful three-day spring meeting of Texas Section, held at Beaumont, Tex., April 17–19, under sponsorship of Section's newly formed Southeast Branch, is directed by this group (left to right): George Davenport, president of Southeast Branch; Wallace Livesay, Section director for Branch; T. C. Forrest, Jr., Texas Section president; and Charles Davidson, general chairman of spring meeting. Devoted primarily to theme of water conservation and usage in highly industrialized southeastern section of state, the three-day program attracted members from all over the State. Prominent among speakers was ASCE President Carlton S. Proctor. Section's annual meeting, to be held in Fort Worth sometime in fall, will feature Centennial of Engineering.

Coming Local Section Events

District of Columbia—Meeting at the Cosmos Club Auditorium, June 10, at 8 p.m.

Los Angeles—Annual field day meeting will take place at the Oakmont Club, Glendale, Calif., on June 24, from 12:30 p.m. to 10 p.m. Reservations are required for dinner, which will be preceded by a series of sports events during the afternoon. Junior Forum Friday luncheon meeting at the Hotel Alexandria at 12 noon.

Nebraska—Tour of Trenton Dam and Swanson Lake will supplement symposium on the construction of the dam to be held at McCook, Nebr., on June 28.

Philadelphia—Meeting at the Engineers' Club, June 10, at 7:30 p.m., preceded by dinner at 6 p.m.

Sacramento—Weekly luncheons every Tuesday at the Elks Temple, Sacramento at 12 noon.

South Carolina—Two-day meeting will be held at Fort Sumter Hotel, Charleston, S.C., on July 25 and 26. Ladies are invited.

INTER-AMERICAN CONVENTION
San Juan, Puerto Rico, November 12–15 1952

Scheduled ASCE Conventions

DENVER CONVENTION
Cosmopolitan Hotel
Denver, Colo., June 16–20, 1952

CENTENNIAL CONVOCATION
Conrad Hilton Hotel
Chicago, Ill., September 3–13, 1952

SAN FRANCISCO CONVENTION
San Francisco, Calif., March 2–7, 1953

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Alaska Southeastern Sub-Section	May 2	30	Dinner meeting. Don Wilson, district director, Alaska Public Works, talked on his organization and its works. Three films on prestressed concrete were shown.
Arizona	April 29	47	Dinner meeting. ASCE President Carlton S. Proctor was guest of honor and principal speaker.
Buffalo	April 15	52	Luncheon meeting addressed by Earl B. Strowger chief hydraulic engineer, Niagara Mohawk Power Corp., on the subject of water supply for large steam plants in the Niagara-Mohawk system.
Central Illinois	April 15	70	Dr. Karl Terzaghi, foundation expert and professor of engineering at Harvard, presented an illustrated talk on rock-fill dams in British Columbia and Algeria, at the dinner meeting.
Central Ohio	April 17	44	Joint dinner meeting with the Ohio State University Student Chapter, addressed by F. Holman Waring, chief engineer, division of sanitary engineering, Ohio Department of Health.
Cincinnati	April 2	37	F. R. Smith, bridge engineer, Union Railroad, spoke on "Human Relations in Railroading," and G. Brooks Earnest, Director of District 9 and president of Fenn College, presented Junior membership awards.
Cleveland	April 25	38	A talk on modernizing the Cuyahoga River was presented by Carl O. Rydholm, marine consultant, Cleveland Cliffs Iron Co.
Connecticut	May 8	54	Dinner meeting. Illustrated discussion on the "Centriline Process of Lining Water Pipes," was given by J. L. Nalen of Raymond Concrete Pile Co., New York.
District of Columbia	April 8	91	William R. Campbell, mechanical engineer, engineering mechanics section, National Bureau of Standards, Washington, D.C., spoke on "Mechanical Tests of Large Structural Elements and Analysis of Welded Ship Failures."
Florida West-Coast Sub-Section	April 15	19	Guest speaker Ross Windom, St. Petersburg city manager, discussed the St. Petersburg sewage disposal project.
Florida Northwestern Sub-Section	April 14	18	"Atomic Safety" was the title of an illustrated talk by James F. Lloyd, lieutenant, U.S. Navy, presented at a dinner meeting.
	May 12	30	Oliver J. Semmes, city manager of Pensacola, was guest speaker at dinner meeting.
Georgia Central Savannah River Valley Sub-Section	March 28	...	Luncheon ~~meeting~~. Clark C. Vogel, assistant general counsel discussed the Atomic Energy Commission. R. K. Mason presented a talk on the construction of Savannah River Plant.

Illinois	March 28	...	Luncheon meeting. Summary of Board of Direction actions at New Orleans meeting given by L. R. Howson.
Intermountain	May 5	30	ASCE President Carlton S. Proctor delivered an address on the role of the engineer in combating the national trend toward socialism.
	April 3	35	Dinner meeting. A talk on sanitation and pollution problems of Utah presented by C. N. Stutz, Utah State Board of Health.
Iowa	April 17	48	Joint technical meeting with North Central Iowa Engineers Club, Fort Dodge, Iowa, featured symposium on municipal improvements.
Lehigh Valley	.....	...	Joint meeting with the American Welding Society. Louis Hauser of Philadelphia, O. J. Bickel, and George Murphy were speakers for the evening.
Los Angeles	May 14	241	Joint meeting with the Los Angeles Engineering Council of Founder Societies and the Structural Engineers Association of Southern California. "Beginning the Second Hundred Years" was the title of address by Frank W. Edwards.
Miami	April 3	24	Dr. H. H. Sheldon, dean of the Division of Research and Industry, University of Miami, gave a talk on research at the university.
Michigan	May 14	...	Life membership certificates awarded to Otto E. Eckert, general manager, Lansing Board of Water and Light, and L. P. Scott, district engineer, Michigan, U.S. Bureau of Public Roads.
Metropolitan	May 22	...	Newly elected officers include William L. Hanavan, president; John P. Riley and Alfred Hedefine, vice-presidents; William J. Shea, treasurer; Frank C. Mirgain, sectetary; Jewell M. Garrelts, James H. Griffin and Richard Hazen, director. The Robert Ridgeway awards went to Charles Wichern, Cooper Union; Robert Gershowitz, City College; Frederick Backer, New York University; Charles F. Plungis, Rutgers; Richard A. Shellner, Newark College of Engineering; John D. Huddelston, Columbia School of Engineering; Charles A. Benedittis, Brooklyn Polytechnic Institute; and Rino Monti, Manhattan College. ASCE President Proctor was principal speaker.
Nebraska	April 26	80	Guest speaker at the one-day luncheon meeting held in conjunction with the 21st annual spring roundup of the Nebraska Engineering Society, was Leo H. Corning, manager of the structural bureau, Portland Cement Association, of Chicago.
Northeastern	April 15	175	Joint meeting with Boston Society of Civil Engineers. Harry S. Spitz, assistant chief construction engineer, United States Steel Corp. spoke on the Fairless Works.
Northwestern	April 7	65	Joint dinner meeting with Minnesota Section of the Society of American Military Engineers. Illustrated talk on design and construction of Garrison Dam, by chief of the engineering section, Garrison District, Corps of Engineers.
North Carolina	May 3	56	Annual spring meeting featured presentation of papers by student chapter members, luncheon meeting, and presentation of junior membership awards.
Philadelphia Delaware Sub-Section	April 15	40	Dinner meeting. E. Zemitis, B. Rutens, and K. Rymkis, all of the Delaware State Highway Department, were guest speakers for the evening.
Pittsburgh	April 22	67	A panel of four engineers presented a talk entitled "Pre-Cast Concrete Sandwich Wall Panel," and a film, to a joint meeting with E.S.W.P. Junior membership awards were also conferred.
Providence	April 10	30	Lecture meeting led by Frank L. Flood, partner, Metcalf & Eddy, who spoke on "Recent Developments in the Field of Sanitary Engineering."
St. Louis	April 21	89	Luncheon meeting. George Weiss of the New York Port Authority spoke on the scope of the Authority's activity and its history.
West Virginia	May 16	83	Dr. Wayne Purcell of Rem-Cru Titanium Inc., Midland, Pa., was principal speaker at dinner meeting.

(Continued from page 67)

future trend and design of heavy highway vehicles. Data on the frequency of vehicles and suggestions regarding design loadings and related factors will be of great value to the committee.

Committee on Seismological Forces

Established in 1949 "to study effects of earthquakes on structures and to evaluate forces arising therefrom," this committee is made up of members from Washington, Oregon, and California. R. W. Binder is chairman. To date a large part of the committee's work has been devoted to compiling existing data and to establishing a starting point for future committee work.

A paper now under preparation will discuss and illustrate the many facets of earthquake damage and will contain a form which will serve as a basis for reporting future earthquake damage so that all information gathered can be brought together in a uniform pattern. Another undertaking is the translation of a Greek text on seismic design.

The committee is eager to receive all available information. Your suggestions and, in particular, translations of pertinent foreign papers will be welcomed. Many of the committee members serve on other seismology committees on the West Coast with the result that the efforts of this committee in no way conflict with the activities of other groups.

Committee on Wind Forces

To assemble, correlate, and summarize existing information on the factors determining wind forces is the first aim of this committee, of which C. H. Gronquist is chairman. In addition, it is the purpose of the committee to indicate what information is lacking, to recommend further research, to supply needed additional data, and to submit recommendations for the determination of the wind forces on various types of structures in a form to be of practical value to the civil engineer.

As a part of the work of this committee, a paper on the subject of "Variation of Wind Velocity and Gusts with Height" has been prepared by R. H. Sherlock, M. ASCE, of the committee, and will be published shortly in the PROCEEDINGS.

The committee is at present engaged in preparing a report which in brief will describe the characteristics of the wind, relations between force and velocity, wind forces on buildings and enclosed structures, and wind forces on bridges and open framed structures. A summary with recommendations will close the report.

NEWS BRIEFS . . .

Attendance at Centennial Convocation Urged at 66th Annual Meeting of EIC

Reaffirming the basic purposes of the Centennial of Engineering at the recent 66th annual meeting of the Engineering Institute of Canada in Vancouver, ASCE Executive Secretary William N. Carey urged attendance at the Centennial Convocation in Chicago, September 3 to 13. The basic Centennial aims, he said, "are to further public understanding of the fundamental principles of government under which the United States has become a great and prosperous nation, and to increase public knowledge of the part the engineering profession has played in that development."

Discussion of recent Canadian construction projects was featured at several of the technical sessions comprising the three-day program. Outstanding among these projects are the huge Nechako-Kemano-Kitimat hydroelectric power development and the adjoining aluminum reduction plant at Kitimat, B.C., described by F. L. Lawton, chief engineer of power development for Aluminum Laboratories, Ltd.; the hydroelectric plant and storage reservoir recently constructed on the Spray River near Banff, Alberta, for Calgary Power, Ltd., discussed by G. V. Eckenfelder, resident engineer for the Montreal Engineering Company, Ltd.; and two steam electric stations of the Ontario Hydroelectric Power Commission, described jointly by T. A. Fearnside, of the Stone & Webster Engineering Corp.; S. L. Fear, of the Hydroelectric Power Commission of Ontario; and R. A. H. Hayes, of H. G. Acres & Company. Other subjects discussed included savings effected by the use of precast reinforced concrete construction on two building projects in Edmonton; corrosion in industry; and allocation of rehabilitation and reconstruction costs after a disaster flood.

In urging participation of EIC members in the Centennial of Engineering in a brief talk given at the annual banquet, Secretary Carey described the Convocation program, culminating feature of the entire Centennial celebration. He said that, "A visual and dynamic presentation of a century of engineered progress will be made at the famous Museum of Science and Industry. This will be carried out through a special engineering centennial exhibit—a look at the past, the present, and the future of engineering. This exhibit will be added to the ten million dollars worth of science and industry exhibits already on view at the museum."

In addition to the programs of more than twenty national engineering societies, to be conducted during the Convocation period, there will be twelve symposium sessions. These Secretary Carey described as "the most important feature of the Convocation program . . . . The symposium session subjects have been selected on the basis of their broad impact on the lives of people and the advancement of civilization. These subjects are: Professional Societies; Education and Training; Food; Tools; Structures and Construction; Transportation; Mineral Industries; Chemical Industries; Communication; Energy; Urbanization; and Health. Each symposium session will be headed by a man eminent in his field. The papers will be in sufficiently non-technical language to interest the public while, at the same time, of real value to engineers. . . .

"The engineering societies of the free nations of the world have been officially invited to attend. We are hopeful that the engineers of the Western Hemisphere will be represented in large numbers, and particularly by our own blood-brothers who live in Canada," Secretary Carey concluded.

During the annual banquet J. B. Stirling, M. ASCE, of Montreal, Que., was inducted into the presidency of the EIC for the coming year. New vice-presidents are A. E. Berry, of Toronto, Ont.; G. T. Malby, of Isle Maligne, Que.; and D. J. MacNeill, of Antigonish, N.S. The banquet, which was attended by over 800 members and guests, terminated the three-day program.

New EIC president John B. Stirling, M. ASCE, of Montreal (second from right) receives good wishes of his predecessors in office. Shown with him, left to right, are Past-Presidents J. A. Vance, M. ASCE of Woodstock, Ont.; Ira P. Macnab, of Halifax, N.S.; and John N. Finlayson, M. ASCE, of Vancouver, B.C.

Need for Research Cited at Building Group Meeting

Government needs for more building research to solve the many technical problems arising in the construction and operation of more than 100 million square feet of building space were reported by W. E. Reynolds, M. ASCE, Commissioner of Public Buildings, at the recent first annual meeting of the Building Research Institute.

The all-day meeting, which was attended by representatives of the member organizations in the Institute and the Building Research Advisory Board, also featured a review of recent BRAB activities, with reports on the housing research survey, the conservation study for the DPA, and policies for stimulating research. The relationship between the Institute and BRAB was examined in a round-table discussion.

The Board of Governors elected the following officers for the Building Research Institute: Norman P. Mason, president; R. E. Zimmerman, vice-president; and William H. Scheick, executive secretary.

BRAB recently sponsored a two-day conference on condensation control in buildings as related to paints, papers, and insulating materials. Research progress in the field was outlined by five technical speakers and practical aspects were discussed by a panel representing various trades. The conference proved conclusively that there is more work to be done, especially in standardizing ratings of various materials in relation to their vapor permeability.

Westinghouse to Build Steam Development Laboratory

Ground was broken recently for a $6,000,000 steam and gas turbine development laboratory at the South Philadelphia Works of the Westinghouse Electric Corp. Actual construction of the four-story, brick and structural steel building will begin late this summer and take about a year to complete. Initially the laboratory will conduct special research for the U.S. Air Force. United Engineers & Constructors, Inc., of Philadelphia, will construct the new building according to specifications developed by the Westinghouse Engineering and Research Departments in Pittsburgh.

Steel Work for Chesapeake Bay Bridge Completed

With erection of final 400-ton deck cantilever truss span, on May 23, Bethlehem Steel Company completes steel work for four-mile-long Chesapeake Bay Bridge, world's third longest. Spanning Chesapeake Bay for first time, new bridge links Del-Mar-Va peninsula to mainland of Maryland. When completed, it will be vital segment of north-south highway enabling traffic to bypass cities of Philadelphia, Wilmington, Baltimore, Washington, and Richmond, Va. Final truss span, 360 ft long and 40 ft deep, was used as falsework or dock upon which a number of other spans were erected and floated into place. This dual use—as falsework and eventually as part of bridge itself—was one of many improved techniques devised by engineers to facilitate construction. Project, described in May 1951 issue, is being built by Maryland State Roads Commission. Engineer is the J. E. Greiner Co., of Baltimore.

George P. Coleman Bridge at Yorktown Dedicated

Opening of the George P. Coleman Memorial Bridge across the York River at Yorktown, Va., on May 7, provides an important link in the north-south highway system. Connecting the Virginia Peninsula with the upper Tidewater country of the state, the $9,000,000 structure is the largest ever built by the Virginia Highway Department in both quantities involved and costs. Construction of the 3,750-ft bridge was begun in December 1949, after the Department of the Interior, the War Department, and the State of Virginia had agreed on a low-level double-leaf swing span as best meeting coastal defense needs and retaining the historic atmosphere of Yorktown.

The designers of the bridge were Parsons, Brinckerhoff, Hall and Macdonald of New York, and it was built by the Virginia Bridge Company of Roanoke (now the American Bridge Division of U.S. Steel Corporation Subsidiaries). Principal contractors on the substructure were the Massman Construction Co. and the Kansas City Bridge Co., both of Kansas City, Mo. The caissons were built by the Newport News Shipbuilding and Dry Dock Co. and towed 45 miles to the construction site. Articles on the project appeared in the February and July 1951 issues of CIVIL ENGINEERING.

Construction Activity Seen in Upswing

Corroboration of an apparent upward trend in construction activity despite defense restrictions on building is seen in a Department of Commerce résumé of the situation in its publication, *Survey of Current Business*. It notes that, "The declining trend in aggregate new construction activity, which had been in progress since the initial quarter of 1951, was halted in the fourth quarter of 1951, and reversed in the first quarter of this year. The 8 percent rise over the fourth-quarter rate, after adjustment for seasonal movements, carried aggregate volume back to the quarterly peak of a year ago. Since unit costs have increased by 3 percent or more over the year, the physical volume is still below a year ago.

"The first quarter brought plus signs in all major types of new construction, including the private segments not directly connected with the defense effort—residential, commercial, and institutional, and to a smaller degree in public non-defense construction.

"These were the areas in which the largest cutbacks in activity had occurred during 1951. The chief factor in the construction pickup was an easing in the supply of critical materials, against the background of a buoyant demand in most segments.

"The construction industry has been one of the first beneficiaries of the release of materials occasioned by the adjustment of military schedules. In a series of actions in the latter part of the quarter, the Defense Production Administration approved an increasing number of applications to commence non-defense projects, with supporting allotments to begin, as a rule, in the final two quarters of the year. In view of the long leadtimes involved, additional applications were invited."

Conferences to Explore Atomic Bomb Effects on Structures

Conferences on the effects on structures of atomic bombs and earthquakes are slated for this June on opposite sides of the country, with the University of California offering a symposium on "Earthquake and Blast Effects on Structures" June 26-28, and Massachusetts Institute of Technology sponsoring a conference on "Building for the Atomic Age" on June 16 and 17. In Los Angeles the symposium is offered through the facilities of the University of California Extension under joint sponsorship of the Earthquake Engineering Research Institute and the university's engineering departments on the Berkeley and Los Angeles campuses. In Cambridge the program is being arranged by the M.I.T. Department of Civil and Sanitary Engineering.

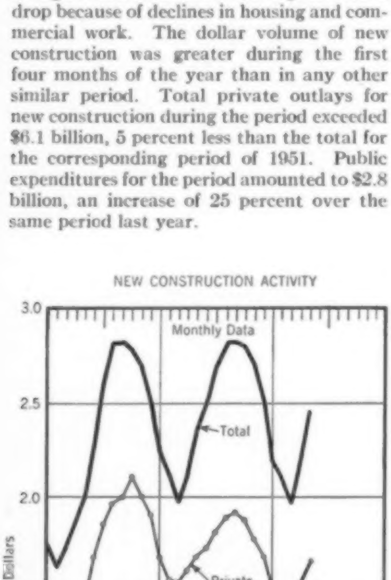
Detailed programs and registration application forms may be obtained from the University of California Extension, Los Angeles 24, Calif., for the West Coast conference, and from the Summer Sessions Office, Massachusetts Institute of Technology, Cambridge 39, Mass., for the M.I.T. meeting.

Construction Activity Sets New Record in April

New construction outlays rose seasonally in April to a total of nearly $2.5 billion, setting a record for the month, according to a joint report of the Building Materials Division of the U.S. Department of Commerce and the Labor Department's Bureau of Labor Statistics. The total value of new construction put in place during the month was 8 percent above the March 1952 total. Private outlays rose 5 percent, and public expenditures increased by 12 percent.

The seasonal upturn in construction activity extended to nearly all types of projects. An exception is noted for private industrial plant expansion, which has reached a peak about one-third higher than a year ago. Private homebuilding activity rose 6 percent during April and was only 7 percent below a year ago. Military construction showed no more than a seasonal advance during the month, although expenditures for military projects were more than two and a half times those of April 1951.

According to the joint agencies, construction activity for the country as a whole has continued at a record rate this year, even though some localities have experienced a drop because of declines in housing and commercial work. The dollar volume of new construction was greater during the first four months of the year than in any other similar period. Total private outlays for new construction during the period exceeded $6.1 billion, 5 percent less than the total for the corresponding period of 1951. Public expenditures for the period amounted to $2.8 billion, an increase of 25 percent over the same period last year.



Increase of 8 percent in April construction outlays over total for March is indicated in Department of Commerce curves.

Finish of N.Y. Thruway Is Expected in 1954

With more than 2,400 engineers engaged in advancing all phases of the planning and construction of the 535-mile New York State Thruway, completion of the project is expected in 1954, barring any worsening of the international situation, according to the second annual report of the State Thruway Authority. Despite steel shortages that have delayed the work, particularly in the building of overhead structures, the report notes that "new construction is rapidly being placed under contract." Enough steel was obtained last year to complete 48 overhead structures and to start the construction of 24 more.

As of December 31, 1951, the status of construction and planning was as follows: Opened to traffic, 41 miles; to be under construction contract by the end of March, 109 miles; plans in various states of completion, 267 miles; and field surveys completed and in progress, 118 miles.

Specialists Needed for Foreign Assignment

Specialists in several of the professional fields relating to housing are needed for foreign assignment under the Point IV Program of the Technical Cooperation Administration of the Department of State, according to an announcement from the Housing and Home Finance Agency. Particularly needed for the work on self-help projects in underdeveloped areas are specialists in shelter improvement and community development activities. Projects now scheduled or in prospect are located in Latin America, Africa, the Middle East, India, and Pakistan. In addition to base salaries, which range from $4,323 to $12,700 a year, Point IV employees generally receive a post differential or allowance and travel and related expenses. Terms of assignment are six months to two years.

Interested persons may obtain booklets describing the program of the TCA and Standard Application Form 57 from Miss Dorothy Boyce, Employment Officer, Office of the Administrator, HHFA, 1621 K Street, Northwest, Washington 25, D.C.

Materials to Be Allotted for School Construction

About 500 school projects that have been deferred because of lack of materials will receive construction permits and allocations of critical materials for the third and fourth quarters of this year, according to an announcement of the Federal Security Agency reported in a recent issue of the *Defense Production News*. School officials receiving construction permits and allocations may proceed immediately with the preliminary work of clearing sites and excavating, and may also place orders for controlled materials, according to Federal Security Administrator Oscar R. Ewing.

The additional authorized projects will include all school facilities for which applications have been received in seven localities designated "employment hardship areas"—namely, New York City, Boston, Washington, Los Angeles, San Francisco, Seattle, and Portland, Oreg. Materials will also be allotted for construction of hospital facilities in these areas.

Elizabeth River Tunnel Is Opened to Traffic

A direct traffic route between Norfolk and Portsmouth, Va., on opposite sides of the Elizabeth River was put into operation on May 23, with the opening of a two-lane vehicular tunnel under the South Branch of the Elizabeth. The tunnel ties into a bridge completed last month over the East Branch of the river. Tunnel and bridge are a combined project of the Elizabeth River Tunnel Commission, created in 1942 by the Commonwealth of Virginia to implement long-discussed plans for a quick vehicular route between the two cities previously connected only by ferry.

Parsons, Brinckerhoff, Hall & Macdonald were consultants on the tunnel phase of the project, with the J. E. Greiner Co., of Baltimore, serving in similar capacity on the bridge. The principal construction contractors were Merritt-Chapman & Scott Corp., of New York on the tunnel and the Tidewater Construction Corp., of Norfolk, on the bridge. The overall cost of the project was $23,000,000.

Film Showing Corrosion in Action Is Available

A new sound and color film, showing how corrosion causes annual losses to industry and other groups estimated at over $6,000,000,000 has been prepared under the direction of the Corrosion Engineering Section of the International Nickel Company. Entitled "Corrosion in Action," the film has been produced for showing in one part, in any combination of two parts, or in the full three-part length, depending on the time available. Each part requires 20 min for showing.

Made essentially for technical, educational, and industrial groups, "Corrosion in Action" will be released for use in schools, colleges, and industrial plants, and before technical societies. Bookings may be made through the International Nickel Co., 67 Wall Street, New York 5, N.Y.

Ancient Italian Bridge Reported Near Collapse

Immediate and extensive restoration is reported necessary to save the famous Ponte Vecchio over the Arno River at Florence. Vehicular traffic over the bridge has been stopped, and plans to save the ancient structure are being studied by both the Italian government and the city. The City of Florence has also collected funds to shore up the quaint shops that constitute the bridge superstructure. Dating back to 1345, the Ponte Vecchio replaces a bridge built in 966. In 1564 a corridor connecting the Uffizi and Pitti Palaces was built over the shops by Giorgio Vasari.

The present damage, consisting principally of wide cracks in the superstructure, is attributed largely to German Army bombing of the buildings at each end of the structure. Experts believe that the three arches of the bridge are in relatively good condition and that it is mainly the superstructure that must be strengthened or possibly rebuilt. The Ponte Vecchio is the sole remaining bridge across the Arno. Five other comparable structures were destroyed by the Germans in their retreat northward in August 1944.

Army to Build More Armories

As part of a long-range program to establish facilities for Reserve units, the Department of the Army announces plans for construction of 25 more armories for Organized Reserve Corps units. The 25 new training facilities, which are being built under jurisdiction of the Army Corps of Engineers, will cost about $9,000,000. A total of 57 armories are already under construction or being completed under the same program.

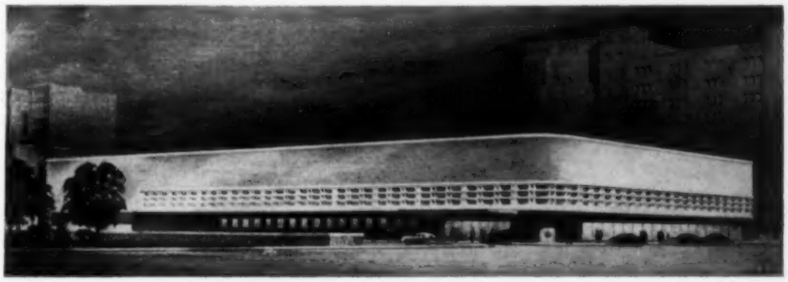
New Technique Adds to Source of Iron Supply

An improved technique that makes it economically feasible to process taconite—a hard stone containing from 24 to 30 percent iron ore—and also increases the value of low-grade iron ore was discussed at the recent meeting of the American Institute of Mining and Metallurgical Engineers in New York.

This technique, described by John R. Green, manager of the steel division of the Brown Instruments Division of the Minneapolis-Honeywell Regulator Co., consists of finer temperature control and greater exactness in maintaining fuel and air ratio and distribution in a taconite "pelletizing" furnace. The proper ratio of fuel and air in the processing of the ore causes it to be delivered with chemical and physical characteristics that equal those of higher grade ore. The method also makes possible maximum fuel economy.

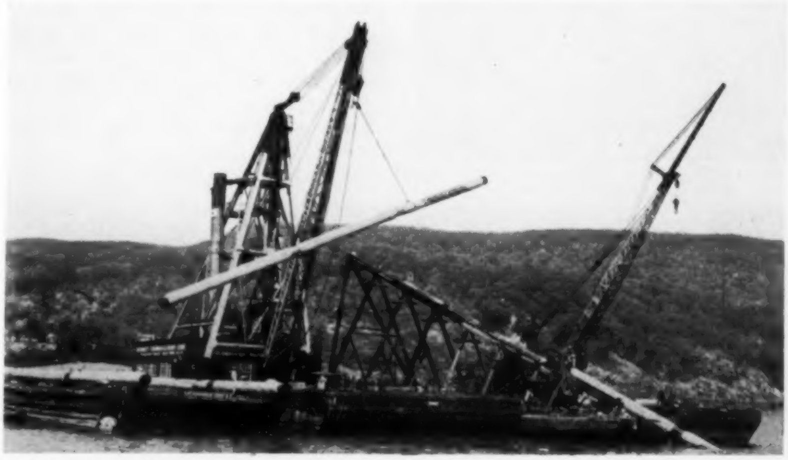
Mr. Green said that the process is especially significant because the nation's deposits of high-grade ore, as now known, are expected to be exhausted in five to ten years whereas there are "billions of tons" of taconite to draw upon.

New Terminal to Consolidate Manhattan Airlines



Construction of New York's new East Side Airlines Terminal Building by Triborough Bridge and Tunnel Authority is proceeding at rapid rate. This $5,500,000 structure, shown here in artist's rendering, will occupy most of city block between 37th and 38th Streets, with speedy access to La Guardia and Idlewild airports. To reduce traffic congestion in area, both airline buses and taxicabs will load and unload inside terminal. There will be 80,000 sq ft of parking space on roof, which will be reached by special ramps entirely within building and by Otis elevators. Differences in elevation at terminal site will be handled by use of Otis escalators, with capacity of 5,000 persons per hour. Erection of terminal represents five years of cooperative effort on part of city, Triborough Bridge and Tunnel Authority, and major airlines serving city.

Floating Derrick Lays Gas Pipeline Under Hudson



Hudson River crossing of gas pipeline is accomplished by floating derrick. Here giant crane lifts 120-ft section of 24-in. concrete-encased main into slot of A-frame skid. Pipe is then welded on skid and lowered into water. Sections are kept afloat by pontoons and gradually sunk into previously prepared dredged channel. Double river crossing was constructed by Merritt-Chapman & Scott Corp., for Ford, Bacon & Davis, Inc., engineers acting as agents for Algonquin Gas Transmission Co. First crossing was completed in January. Second was started on April 16 and completed on May 7.

Bell-Bottom Caissons Support Detroit City-County Building Foundations

Methods employed in design of the foundations for the new City-County Building under construction in Detroit are attracting wide attention because of the soil conditions involved and the heavy structural load to be carried. The second unit in Detroit's riverfront Civic Center, the project is being built at the corner of Woodward and Jefferson avenues. The first unit in the center, the Veterans' Memorial Building was completed in 1949.

The present project actually consists of two structures, one for city and county office space and one to house the county courts, connected by a 38 by 40-ft link over the Bates Avenue sewer. The office unit is 262 by111 ft with an area of 11,800 sq ft, and the courts structure 155 by 76 ft with an area of 11,800 sq ft. Building frames are of structural steel ,with a total weight of about 8,500 tons. Average live plus dead loads on the upper floors amount to 150 psf. The first floor of reinforced concrete slab is designed for a 250-lb live load in order to permit use of the basement areas as bomb shelters. Basement areas are designed for a live load of 200 psf.

Eleven test borings made indicated that the soil consisted of a hard crust of yellow clay approximately 10 ft thick, underlain by a 100-ft strata of soft blue clay over a 13-ft hardpan strata, all resting upon bedrock. Foundations for the building proper were to rest upon 126 caissons to be excavated to hardpan, about 115 ft below street level, or elevation +5 ft −0 in., belled-out to spread the load to a maximum of 15 tons per sq ft and a minimum of 10 tons per sq ft. The maximum column load was 3,311 kips, the minimum 908 kips. Caissons were to carry 555 kips each. Actual loads for which the caissons were designed consisted of the column load, the basement floor load, weight of the caisson cap, and weight of the caisson. Since the concrete in the caissons was to be poured against undisturbed earth, the shearing, or frictional resistance of the soil as determined by the soil report (average 220 psf) was deducted from the total of the above loads. This offset the weight of the caisson itself. From this load, the required bell area was determined for each caisson, using bearing values of 10, 12, and 15 tons psf. A further practical consideration affected the shaft size chosen. In order to avoid excessive undercutting in excavating the bell, the shafts were so proportioned that the maximum undercut to form the bell would not exceed 3 ft 6 in. and with an average undercut of from 18 to 24 in.

Sinking 100-ft Gow caissons for foundations of Detroit City-County Building is shown in general view below. Left-hand photo gives close-up of nest of 16-ft Gow cylinders extracted from caisson excavation. Lugs on lower ends of cylinders engage cylinder of next larger diameter above, so that set of cylinders telescoped together can be lifted out as concrete level rises to top of largest cylinder.

The caissons extend from 90 to 92 ft below basement grade, which is 20 ft below street grade. Holes for the caissons are sunk by a special rotary drill, with an expansion auger—similar to the method used in caisson drilling for the Veterans Memorial Building.

The caissons are cast in place inside a set of nestable steel casings of 2-in. diminishing diameter for each 16-ft section. Top diameters of the caissons vary from 58 to 84 in. The holes are belled-out at the bottom on a 1-on-2 slope, with provision for a 12-in.-thick pad of concrete at the bottom of the bell.

The rig for excavating the holes for caissons is mounted at the front of an all-electric crane, powered by a 75-hp electric motor. The auger has a nominal cutting diameter of 48 in., equal to the diameter of the smallest section of casing on the job. For drilling holes larger than 48 in., two adjustable reaming knives at the top of the auger are adjusted to the proper length. During clockwise rotation these knives turn out and cut to the required diameter, dripping the material into the top of the auger. At the same time the auger continues boring at the bottom of the hole. During counterclockwise rotation, the knives fold in against the auger.

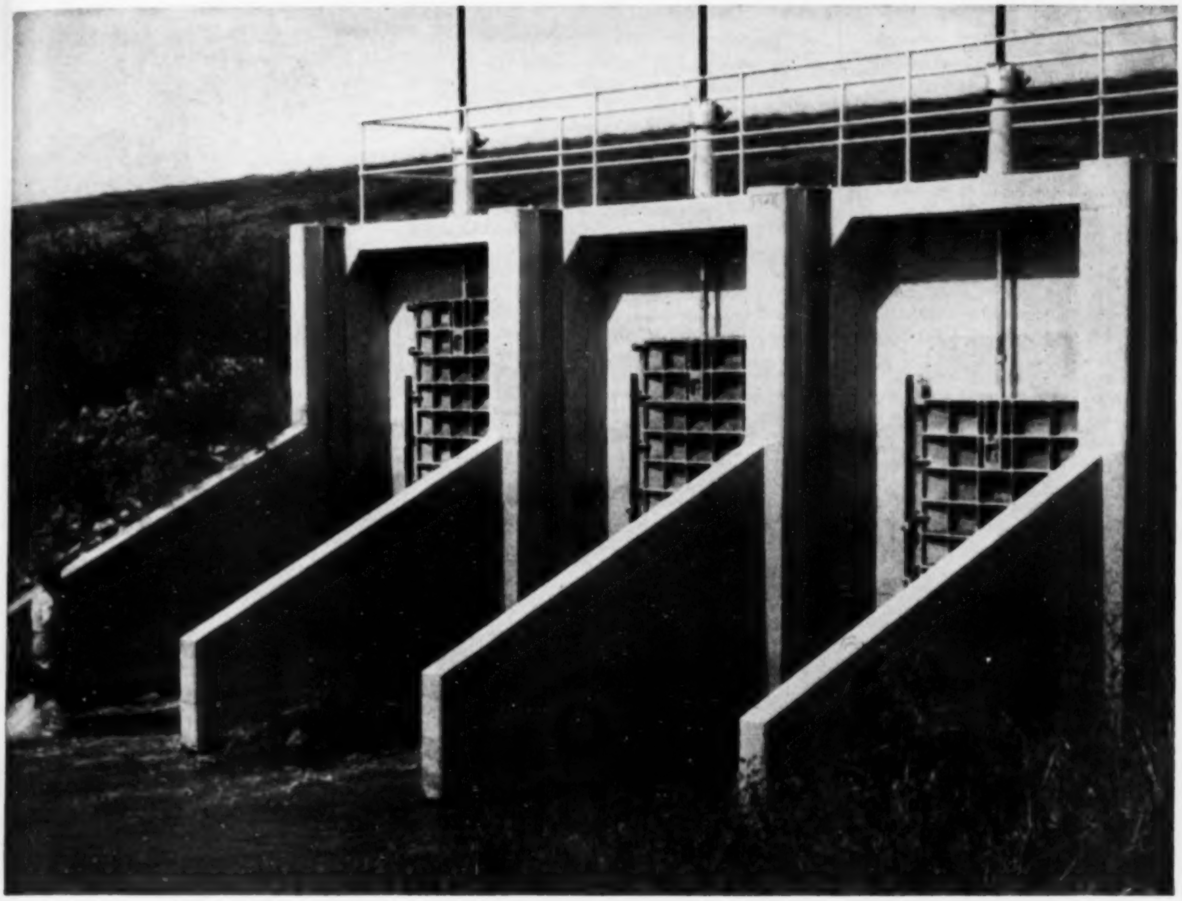
Following completion of the top 16 ft of hole, the first 16-ft section of steel casing is lowered into position. Cutting knives on the auger are retracted 1 in., and a second 16-ft depth of hole is bored and encased with the second section of casing which is 2 in. smaller in diameter than the top section. This procedure is followed until the hole is bored to its proper depth and cased with six sections of the nestable casing. Two sets of casings are provided for each size of caisson.

Boring varies from fairly easy at the top of the hole to extremely hard just before reaching the bottom. When boulders are encountered they must be removed by workmen lowered into the hole. After a hole has been bored to its full depth and all casings are installed, field tests are made and soil samples taken from the bottom of the hole to determine the diameter of the caisson-bell, depending on the soil bearing value.

Original design of caisson shafts and bells was based on a 15-ton per sq ft design limit for bearing. But the material at the bottom of the holes has such a high carrying capacity that bell-diameters are redesigned from the field tests to carry loads based on a 25-ton per sq ft design limit.

The belled-out portion at the bottom of each caisson is excavated by workmen with air spades, and the material hoisted out of the hole by an electric hoist. The concrete chute is telescoping. It is made up of four 24-ft sections of 8, 10, 12, and 14-in.-dia pipe, the larger pipe being at the bottom of the hole. One workman is in the hole while placing concrete, and the bottom of the chute is kept about 4 ft above the top of the concrete.

The casings are retracted as the hole is



filled with concrete, each telescoping into that immediately above it. But the rate of retraction is such that the bottom of the casing is always from 4 to 6 ft below the top of the concrete. Concrete in the caissons has a 2-in. slump and tests at least 3,000 psi compression at 28 days. Casings are lowered into the holes with a crawler crane, and removed with a special pulling rig. This rig is positioned over the hole by crawler crane. It has four legs, one pair consisting of trussed steel pipe, the other of braced steel beams that mount the hoisting equipment. The complete rig has a maximum pull of 100 tons.

The six nestable sections of casings are pulled out of the concrete-filled hole by the lifting rig, and seated on a platform of 12 × 12-in. timbers laid across the starting pit at the top of the caisson. The lifting rig is then removed by crawler crane and placed over another caisson being concreted.

In the meantime, the first nest of casings is dismantled by crawler crane, cleaned and oiled on the inner surface. The telescoping concrete chute is retracted by the same yoke that pulls the casing out of the concrete-filled hole. It is laid out on the ground, dismantled and hosed clean.

The Detroit engineering and architectural firm of Harley, Ellington & Day, Inc., is designing the City-County Building and furnishing field supervision, with Raymond C. Mauck as resident engineer. Other personnel connected with the project include Malcolm R. Stirton, partner; Benson J. Wood, A.M. ASCE, chief structural engineer; and Fred J. Hildebrandt, manager of construction.

Soil studies and laboratory analyses were made under the direction of William S. Housel, M. ASCE, professor of civil engineering at the University of Michigan. The O. W. Burke Co., of Detroit, is the general contractor, and the Raymond Concrete Pile Co., holds a subcontract for sinking and concreting the 126 caissons.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"Lucky me!" exclaimed Joe Kerr, "for having learned surveying the hard way."

"What's the hard way?" asked Professor Neare.

"Pounding line and punching stakes, for long miles on hot days and short miles in the winter. Otherwise, I couldn't have solved your problem involving Bill Doyle Rhodes' law of traffication."

"I didn't think you could, Joe."

"Well, I did. I let x and y be the distances from Centerville to Hitherville and Yonderville, respectfully, and T be the trafficational constant. Then from the data and Rhodes' law:

$$2{,}191 = \frac{1{,}100 \cdot 1{,}386}{Tx^2}$$
$$3{,}091 = \frac{2{,}800 \cdot 1{,}386}{Ty^2} \quad . \; . \; . \; . \; (1)$$

Dividing one by the other to eliminate T, I found $y = 1.3432x$. Now, if the towns are on section corners, y and x must be integers with the unit 'miles, government measure.' Noticing that $y = 4$, $x = 3$ would nearly fit, I concluded that $y = 4.0148$, $x = 2.9{,}889$ miles in the resurvey, the error of less than 20 ft per mile being not uncommon. That's what I meant by long and short miles."

"Joe's smart," conceded Cal Klater, "but he overlooked the thru traffic from Hitherville to Yonderville, making

$$2{,}191 = \frac{1{,}100 \cdot 1{,}386}{Tx^2} + \frac{1{,}100 \cdot 2{,}800}{T(x+y)^2} \quad . \; . \; (2)$$
$$3{,}091 = \frac{2{,}800 \cdot 1{,}386}{Ty^2} + \frac{1{,}100 \cdot 2{,}800}{T(x+y)^2}$$

Subtracting the first from the second and reducing,

$$T = 154\left(\frac{28}{y^2} - \frac{11}{x^2}\right) \quad . \; . \; . \; . (3)$$

which can be substituted in (2) to find:

$$\frac{313 \cdot 14^2}{y^2} - \frac{281 \cdot 11^2}{x^2} = \frac{32 \cdot 25^2}{(x+y)^2} \quad . \; . (4)$$

from which it is evident that $x = 11$ and $y = 14$ perfect miles."

"Cal's right, but," added the Professor, "we should prove there is only one answer. Expanding (4) and factoring,

$$(14x - 11y)(4{,}382x^3 + 12{,}207x^2y + 10{,}116xy^2 + 3{,}091y^3) = 0 \quad . \; . \; . (5)$$

If the second factor is zero, either x or y must be negative, which can't be. Equating the first factor to zero and solving in integers, we obtain Cal's solution and all the exact multiples, but for all multiples $x + y$ would exceed the limit of 40 miles.

"Now, on a return visit, Guest Professor Stoop Nagle has what he calls a real easy problem."

"It really is easy, Noah. A nonagonal parcel of land was described by the following latitudes and departures of the midpoints of the sides: (50, 74); (31, 68); (12, 62); (6, 40); (12, 18); (37, 12); (56, 34); (62, 62); (62, 74). Asked to compute the area, Otto Nobetta carelessly interchanged the coordinates of one of the midpoints and was then unable to draw the nonagonal figure. Instead he drew an octagon thru 8 midpoints, using the 9th as a vertex, from which he managed to calculate the area correctly. Which point was miscopied?"

[Cal Klaters were: W. C. Hunter, W. P. Linton, A. Nuther Nutt, Flo Ridan (Charles G. Edson), Stoop (John L.) Nagle (the Guest Professor), Howard G. Housley, and E. P. Goodrich.]

Turnpike Safety Records Cited by Two Authorities

A favorable outlook for safe travel on turnpikes is reported by both the Pennsylvania Turnpike Commission and the New Jersey Turnpike Authority. The 1951 traffic accident report of the Pennsylvania Turnpike Commission shows a marked decrease in fatalities and accidents in proportion to the number of vehicles using the superhighway, amount of mileage traveled, and the increased length of the system. Based on standards approved by the National Safety Council, which for comparative reasons uses a unit of 100,000,000 vehicular miles of travel, the 1951 fatality rate was 8.5 compared to 12.4 in 1950. The Commission attributes the encouraging decrease in accidents and fatalities to more diligent effort on the part of police patrols and safety engineers for many of the commercial fleets using the system as well as to more careful and intelligent driving on the part of the majority of drivers, especially commercial vehicle operators.

For the first three months of 1952 accidents on the recently opened New Jersey Turnpike totaled 223 which, based on the standard formula of the federal and state governments in reporting accidents, were equal to 172 per 100,000,000 miles of travel. Though comparative reports for the state are not available, the latest figures covering the first ten months of 1951 showed, by comparison, 381 accidents per 100,000,000 vehicle miles of travel. This means that the Turnpike averages less than half as many accidents as the other state highways.

New Maintenance Hangars Designed for Air Force

New maintenance hangars, capable of handling the largest aircraft ever produced, are being designed by the Kuljian Corporation, of Philadelphia, for the U.S. Air Force under a contract with the Army Corps of Engineers. All are of double cantilever design in three basic sizes, the smallest of which can be expanded. The largest of the units has ground-floor dimensions of 600 by 200 ft. An innovation in design calls for location of the shops in the center of the hangar instead of along the two sides. Door openings are 60 ft high, and each door is operated by separate built-in motors controlled by push buttons.

ENGINEERING SOCIETIES

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

Sanitary and Civil Engineer; A. M. ASCE; 35; married; 12 years' varied experience with particular emphasis on design, construction, and operation of water, sewage systems and treatment plants. Desires position with high degree of responsibility or teaching position. Will consider any location. C-744-505-A-2-San Francisco.

Commissioner of Public Works, Project Manager, City Manager; A. M. ASCE; Florida Engineers Society '52, registered surveyor in Pennsylvania '30; 25 years' proved ability in all phases of municipal management, engineering and construction; large-scale housing design, construction and operation direction; specifications, bidding, contractor and public relations; confidential investigations; available 20 days after notification; foreign or domestic duty. C-745.

June Graduate; Student Chapter member; with law degree '50; will receive degrees in civil engineering and in industrial engineering. Desires position with progressive construction company. Particularly interested in cost and method analysis. Has had experience as sheetmetal worker, machinist and aircraft mechanic. C-746.

Civil-Architectural Engineer; A. M. ASCE; 41; married; B. S. in C. E.; 17 years' office experience, same field; 11 1/2 years' structural, specifications, architectural details for buildings; 1 1/2 years sewer and plant layout; 5 years' bridge and highway work. Desires responsible position with architectural engineer or large company, preferably Atlantic Coast states. C-747.

Civil Engineer; J. M. ASCE; M. S. in C. E.; major, soil mechanics; minors, structures and mathematics; 3 years' teaching graduate and undergraduate subjects, including soil mechanics, structures, reinforced concrete design, and surveying. Desires position with consulting firm or other employment requiring knowledge of soil mechanics and structures. C-748.

Civil Engineer; J. M. ASCE; B. S. in C. E.; 30; 7 years' engineering, educational and promotional experience with national organization in highway and transportation field. Work includes planning and administration of research and educational program; technical and semi-technical report writing. Location preferred, West or Mid-West. C-749-337-Chicago.

Field Engineer; J. M. ASCE; 27; single; B. S. in C. E.; 1 1/2 years' experience with erection department of structural steel firm; 2 years as carpenter on concrete construction; 1 year with land surveyor, field and office. Location preferred, northern California or Latin America. C-750-525-A-1 San Francisco.

Civil Engineer; M. ASCE; 48; married; 27 years' experience in the design and execution of large irrigation, road and building projects. Has carried out complete river valley schemes including surveys, plans, estimates, reports and construction. Can take complete charge of any large scheme. Available immediately. Resident of India. C-751.

Structural Engineer; J. M. ASCE; 33; registered; 12 years' experience in industrial, commercial and public work as designer and head of department. C-752.

Civil Engineer; J. M. ASCE; B. S. in C. E., 1942; 30; married; 2 1/2 years' experience in aircraft stress analysis; 2 years' experience engineering instruction; 2 1/2 years' experience in field engineering and construction. Desires field engineering work in construction, preferably foreign assignment; permission must be given for wife to accompany applicant. C-753.

Civil Engineer; J. M. ASCE; B.C.E., 1951; age 25; 1 1/2 years' experience in water supply and sewerage field and office work; desires position in which college training in structural steel design or reinforced concrete design or both would be used to advantage; opportunity for advancement. Available September 1; no location preference. C-754.

Civil Engineer; J. M. ASCE; B.S., January 1952; member Tau Beta Pi; 28; married; veteran; commercial pilot's license, single and multi-engine, 750 hours; desires position in which engineering and flying experience can be utilized. C-755-355-Chicago.

Positions Available

Civil Engineer, under 40, with at least 10 years' industrial building construction and plant engineering experience, to supervise plant expansion, equipment installation, etc. Salary open. Location, Liberia. Y-6586.

Engineers. (a) Water Works Engineer, senior, experienced in operation, management and construction of water utility plants, to direct hydraulic studies and design for improvements, and to direct supervision of operation. (b) Junior engineer, recent civil graduate, interested in water works utility plant. Salaries open. Location, New York State. Y-6604.

Civil Engineer, graduate, with 3 years' experience in drafting and design of structural details or any equivalent combination of education and experience with a maximum substitution of 2 years' experience for 2 years' of college unless a registered professional engineer. Salary, $4,576–$5,460 a year. Location, Virginia. Y-6629 (a).

Civil Engineer, graduate, with at least 8 years' design and field experience on waterfront construction, pumphouse, office building, tank foundations, to design bulk terminals with occasional field inspection work. Salary, $6,000–$8,000 a year. Location, New York, N.Y. Y-6647.

Construction Superintendent, civil graduate, 35–45, with at least 5 years' field engineering and supervisory building construction experience, to take charge of housing projects, hospitals, etc., for general contractor. Salary, $6,000–$9,000 a year. Location, Panama and Caribbean area. Y-6655.

Professor in Civil Engineering, graduate, to head civil engineering department. Teaching experience in the field of structures and applied mechanics preferred. Salary, $6,000–$7,500 a year. Location, Virginia. Y-6690 (a).

Architectural Engineer, preferably with 5 years' experience in institutional building layout, particularly hospital work. Salary $7,500–$9,000 a year. Location, Connecticut. Y-6696.

Construction Field Engineer, 30–50, with heavy industrial construction experience, to supervise field layout of foundations reinforcement, structural steel, etc. Salary, $7,800 a year plus bonus. Location, Chile. Y-6755 (a).

Foundation Engineer with 10 years' experience designing heavy foundations and bridge piers. Advanced degree in structures desirable. Knowledge of soil mechanics essential. Capable departmental responsibilities in small organization. Location, East. Y-6776.

Civil or Structural Engineers, recent graduates with degrees, for work, including the determining of structural and architectural requirements, preparing working drawings, specifications and estimating for the construction of power plants, subways, wharves, subaqueous tunnels, wind tunnels, transmission towers and industrial structures. Must be capable of doing structural design work. Will be given drafting and design assignments in connection with various projects. Salaries open. Location, Massachusetts. Y-6803.

Sanitary Engineer with at least 3 years experience in sewer and waterworks design and construction. Immediate assignment as resident engineer on large sewage treatment plant. Salary dependent upon experience and ability. Location, Michigan. Y-6828.

Design Engineer, civil, with 3 to 5 years' concrete structure experience in the design of small dams, irrigation systems, structures and foundations. Duration, 1 year to 18 months. After 3 months may take family at company expense. Salary, $10,800 a year. Location, Peru. Y-6847.

Graduate Assistants for research projects in hydraulics, hydrology, soil mechanics and structural engineering. Half of time will be spent in research work and the other half in graduate work, making it possible to secure master's degree in 2 years. Positions start September 16, 1952. Location, Connecticut. Salary, $1,740 for 9 months, half-time service. Y-6897.

Special Assistant to the Director of Installations, with broad background of experience, preferably in civil or construction fields, plus executive and staff management experience. Duties will include construction coordination program development, material allocation. Salary, $13,000 a year. Location, Washington, D.C. Y-6907.

Engineers. (a) Structural engineer with minimum of 5 to 10 years' experience in industrial plant, particularly chemical construction. Salary, $7,800 a year. (b) Sanitary engineer for project leader, on design of sewerage plant and sewerage collection. Salary, $7,200 a year. Location, Georiga. Y-6932.

Instructor or Assistant Professor in civil engineering, to handle instruction in surveying. Must have advanced degree. Salary, open. Location, New England. Y-6950 (a).

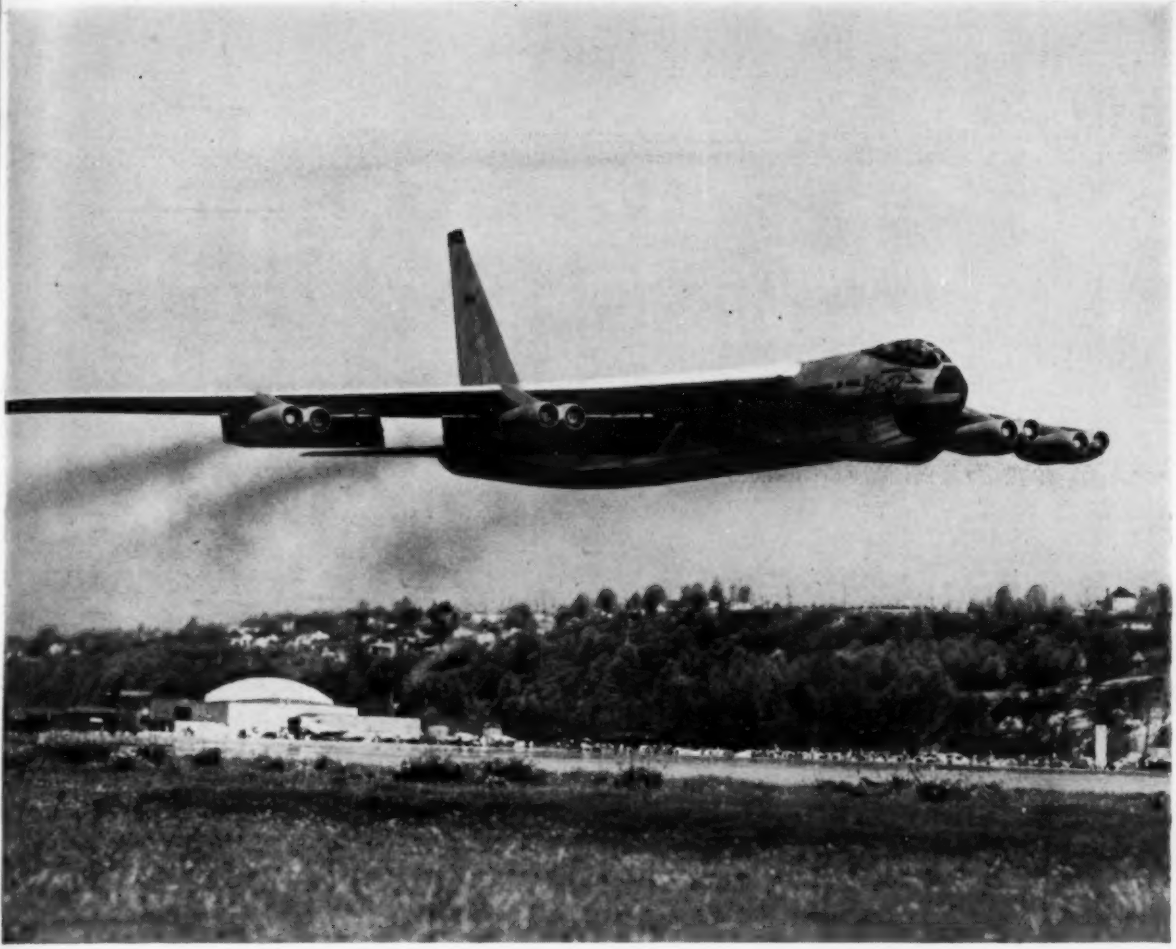
Construction Superintendent with at least 10 years' experience, to travel through the State of New York to supervise construction superintendents on the jobs. Must have good background as superintendent on both frame buildings, wood-type construction and concrete construction. Salary, $6,500 a year plus traveling expenses. Y-6979.

Resident Engineer with at least 10 years' concrete and general construction experience covering roads, retaining walls, buildings, etc. Duration 12 to 18 months. Salary, $10,000 a year. Location, Labrador. Y-7017.

Engineers. (a) General superintendent with considerable experience in the construction of chemical plants, including plant layouts, railroads, roads and drainage. Salary, $9,000–$10,200 a year. (b) Construction engineers, on industrial building construction, particularly chemical plants of brick and stone. Salary, $7,800–$9,000 a year. Location, Boston, Mass. Y-7039.

Sales Engineer, civil graduate, 23–30, with some highway or airfield construction and maintenance experience to sell asphalt products and accessories. Salary, $4,500 a year plus expenses. Location, Long Island, N.Y. Y-7043.

Civil Engineer with engineering degree or 4 years' experience in technical education or combination of education and experience equivalent to four years' education, with 2 1/2 years' engineering experience including at least a half year of difficult and important work in civil engineering. Knowledge of geology, meteorology, photogrammetry, cadastral engineering, architectural and civil engineering. Will review data for accuracy engineering detail and proposals for new construction and alterations in existing facilities, and make study of fuel-storage facilities at various



installations to determine what fields are capable of servicing the B-36 airplane. Salary, $5,940 a year. Location, Midwest. Y-7065.

HYDRAULIC OR SANITARY ENGINEERS, 35–40, technical graduate, experienced in this field, capable of structural and hydraulic design for company in the municipal field involving investigations, reports, design and supervision of construction of water supplies, treatment and distribution, sewage collection and treatment, airfields, storm drainage, streets and related types of work. Should be able to make investigations and prepare engineering reports, meet and discuss projects with clients. Should have southern background. Salary open. Location, South Carolina. Y-7070.

CIVIL ENGINEER, young, with some construction experience, knowledge of soil mechanics and ground water flows desirable. Salary commensurate with ability. Location, Midwest. Y-7108.

CIVIL ENGINEER, under 40, with structural design and office engineering experience, to prepare plans, specifications, etc., on oil field construction projects. Salary, $11,640 a year base pay, plus $4,200 a year living allowance. Location, South America. Y-7112.

SPECIFICATION ENGINEER, civil engineer or mechanical engineer, with 5 years' experience writing specifications for steel plants and equipment. For writing specifications for steel plants and equipment. Salary $7,200-$8,500 a year. Employer will negotiate fee. Location, Chicago, Illinois. R-8768.

DESIGNER, civil engineer, about 30; with at least 5 years' experience in structural steel and concrete design on hydroelectric power plant work. Knowledge of hydroelectric plants, design, detail and check structural drawings on hydroelectric power plant work, for consulting engineer. Salary, $6,000 and up. Employer may negotiate fee. Location, Chicago. R-8865.

Non-ASCE Meetings

American Society for Testing Materials. The fiftieth anniversary meeting and tenth exhibit of testing apparatus and laboratory supplies of the American Society for Testing Materials will be held at the Hotel Statler and the Hotel New Yorker, New York City, from June 23 to 27.

American Society of Mechanical Engineers. The semi-annual meeting of ASME will be held at the Sheraton Gibson, in Cincinnati, Ohio, June 15–19.

American Society for Engineering Education. The American Society for Engineering Education will hold its annual meeting at Dartmouth College in Hanover, N. H., June 23–27.

American Institute of Electrical Engineers. The Nicollet Hotel in Minneapolis, Minn., will be headquarters for the summer general meeting of the AIEE, from June 23 to 27.

Forest Products Research Society. The sixth annual national meeting of the Forest Products Research Society will be held in Milwaukee, Wis., June 23–25.

Conference on Soil Stabilization. A three-day conference on soil stabilization will be held at the Massachusetts Institute of Technology from June 18 to June 20, to examine current problems in stabilization treatment. Sponsoring the conference with M.I.T. are the Bureau of Yards and Docks, the Corps of Engineers, the Highway Research Board, the Massachusetts Department of Public Works, and the U. S. National Council on Soil Mechanics and Foundation Engineering.

Chi Epsilon. A picnic will be held at Lake El Enchata, near Malibu, Calif., on June 22, at 2 p.m., for the members and friends of Chi Epsilon.

Chamber of Commerce of the United States. The theme of the fourth national Businessmen's Conference on Urban Problems will be "Business Action for Better Cities." The conference will be in session on June 23 and 24, at the Multnomah Hotel, Portland, Oreg.

UPADI. A meeting of the UPADI (Union Panamericana de Asociaciones de Ingenieros) will be held in New Orleans, La., August 26–30. The UPADI special committee of United States engineers appointed to work out final plans for the meeting consists of J. M. Todd, chairman; E. A. Pratt, vice-chairman; and S. E. Reimel, secretary.

DECEASED

Charles L. Warwick, Executive Secretary of ASTM, Dies

Charles Laurence Warwick (A.M. '20) civil engineer and executive secretary of the American Society for Testing Materials, died in Philadelphia, on April 23, at the age of 63. Active in the ASTM since 1909 when he graduated from the University of Pennsylvania, he served as assistant secretary while he was instructor and assistant professor at the University. In 1911 he was appointed secretary - treasurer and in 1946 became executive secretary. He made many notable contributions to the field of standardization and research in materials and was recognized as an outstanding authority on materials. During World War II, he headed the specifications branch, Conservation Division of the War Production Board, and later was in charge of the Materials Division.

C. L. Warwick

Charles Stuart Clark (M. '23) vice-president of the Calhoun County Canal Co., Port Lavaca, Tex., died there on April 6 at the age of 71. Beginning in 1918, Mr. Clark was a member of the Texas Board of Water Engineers at Austin for 30 years, and held the chairmanship for several years. Earlier he had worked on land subdivision and designing canal systems for the Southern Pacific Railroad Co.; the St. Louis, Brownsville & Mexico Railroad Co.; Central Irrigation Co., Brownsville, Tex.; and the Donna Canal Co. Mr. Clark became connected with the Calhoun County Canal Co. in 1948. He attended the Agricultural and Mechanical College of Texas.

Alger Crocheron Gildersleeve (M. '15) retired civil engineer, died at his home at Far Rockaway, N.Y., on May 3, at the age of 83. Mr. Gildersleeve was employed at various times as assistant engineer with the New York City Department of Docks; chief engineer and general manager of the Alamo Construction Co., New York; and as consulting engineer with John C. Rodger, New York contractor, the Snare & Triest Co., of New York and Havana, and the Missouri, Kansas & Texas Railroad. From 1895 to 1902 he was head of the firm of Gildersleeve & Rolf, and was engaged in consulting practice in New York from 1915 until his retirement in 1927. Mr. Gildersleeve was an alumnus of Columbia University.

Frank Henry Feller (M. '14) of Trumansburg, N.Y., died on October 19, 1950, at the age of 75, according to information recently received by the Society. Early in his career, Mr. Feller operated his own engineering company in Spokane, Wash., for ten years. He served overseas during World War I, as a captain in the U. S. Army, and upon his return was construction engineer for the Iowa Highway Commission at Sac City. Later he was bridge engineer for Spokane County for four years, and construction engineer and superintendent for the Department of Public Works, Ithaca, N.Y., for nine years. Since 1935, Mr. Feller had been engaged in private consulting practice in Trumansburg.

Solomon Jacob Harwi (A.M. '22) consulting engineer of Bayonne, N.J., died there on March 17, at the age of 86, Mr. Harwi was employed in several capacities by the Lehigh Valley Railroad Co., from 1886 to 1893. Following that, he was connected with the firm of Babcock & Wilcox, as draftsman and construction engineer for nine years, and beginning in 1910 was city engineer for five years. At various times he has also been associated with the Aetna Explosive Co., the Engineering Research Corporation, and the Board of Economics and Engineering, New York, N.Y. Mr. Harwi received a degree in civil engineering from Lehigh University.

Robert Engler Neumeyer (A.M. '97) executive director of the Bethlehem Housing Authority, Bethlehem, Pa., died there on February 26 at the age of 85. From 1890 to 1892 Mr. Neumeyer was employed as a draftsman for the Norfolk and Western Railroad in Virginia. Following that he served for 26 years as city engineer of Bethlehem, and then was engaged in the general contracting business until 1935. He held the position of district engineer for the State Highway Department from 1935 until 1939, when he became connected with the Bethlehem Housing Authority. Mr. Neumeyer received his degree from Lehigh University.

Charles Elmer Black (A.M. '48) associate engineer of design, City Bureau of Engineering, Surveys and Zoning, Philadelphia, Pa., died on December 8, 1951, at the age of 46. Mr. Black's entire career was spent with the city Bureau, which he joined in 1923. He attended the Drexel Institute of Technology.

William Francis Tueting, Jr. (A.M. '45) lieutenant commander, Bureau of Ordnance, Department of the Navy at Washington, D.C., died at his home in Silver Springs, Md., on March 24. He was 37 years old. Before entering the Civil Engineer Corps of the U.S. Naval Reserve, Commander Tueting worked for the Department of Agriculture, the North Dakota Highway Department, and the U.S. Engineer Office at St. Paul, Minn. He was an alumnus of the University of North Dakota.

Lewis Jerome Johnson (M. '04) professor emeritus of civil engineering at Harvard University, died in Cambridge, Mass., on April 15, at the age of 85. Professor Johnson received degrees from Harvard University and the Lawrence Scientific School and also studied in Switzerland and Germany. He joined the Harvard faculty in 1890 and taught there continously until his retirement in 1934, except for two brief interludes when he was engaged in private practice in Chicago, and as professor of civil engineering at Massachusetts Institute of Technology. After retirement from Harvard, he taught for six years in the Division of University Extension, Department of Education, Commonwealth of Massachusetts. He was responsible for the design and construction of the Harvard University Stadium.

Roger Leroy Morrison (M. '22) professor of highway engineering at the University of Michigan, Ann Arbor, Mich., died on March 23. He was 73. Professor Morrison taught highway engineering at the University of Tennessee from 1911 to 1912, and at the Agricultural and Mechanical College of Texas from 1914 to 1918, and had been at the University of Michigan since 1924. He was also connected with the Pittsburgh Testing Laboratories, Birmingham, Ala., as engineer of tests, and with the Concrete Products Co., Birmingham, as treasurer and general manager. Author of *Elements of Highway Engineering*, Professor Morrison was director of the Michigan State Highway Laboratory, and consulting engineer on highway and traffic problems on many projects throughout the country. He held degrees from the University of Illinois and Columbia University.

Ralph Davenport Mershon (M. '07) retired engineer of Miami, Fla., died at his home on February 14, at the age of 84. After receiving a degree in mechanical engineering from Ohio State University, Mr. Mershon taught there for a year before joining the staff of Westinghouse Electric & Manufacturing Co., where he engaged in experimental work, designing, and field installation. Except for a brief interval, he was with Westinghouse from 1891 to 1900. From the latter year until his retirement 35 years later, Mr. Mershon practiced in New York as a consulting engineer.

Clinton Kemp Yingling Jr. (M. '39) structural engineer with the Public Buildings Branch, Procurement Division of the U.S. Treasury Department, at Washington, D.C., died at his home in that city, on April 19. He was 55. Following graduation from George Washington University, he was associated with the Wardman Construction Co. for five years and did the structural design of many buildings including the Wardman Park Hotel Annex, the Carlton Hotel, and the Shoreham Office Building. Since 1930 he has been in charge of design with the Public Buildings Branch. During World War I, Mr. Yingling served as an officer in the U. S. Navy.

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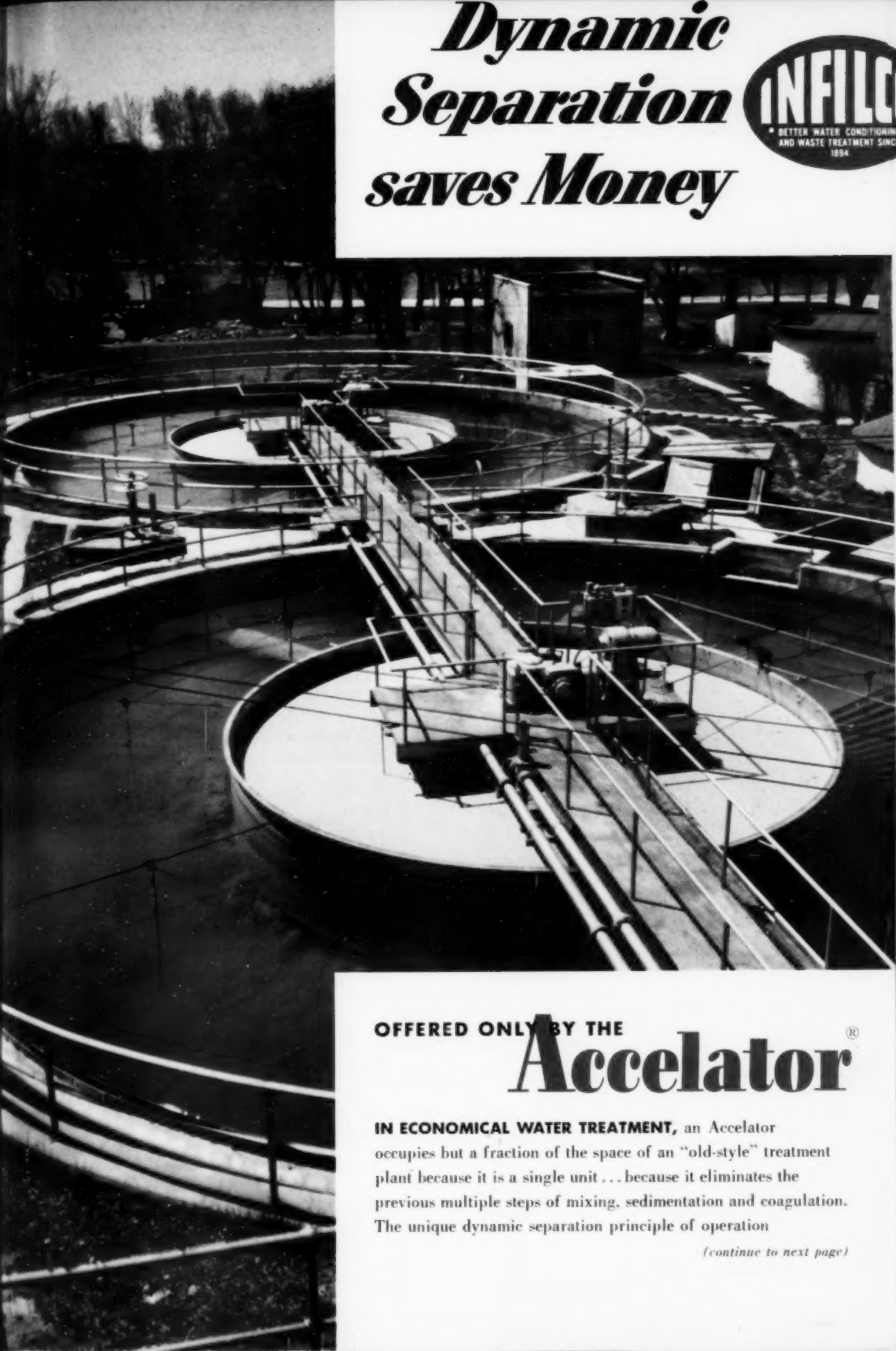

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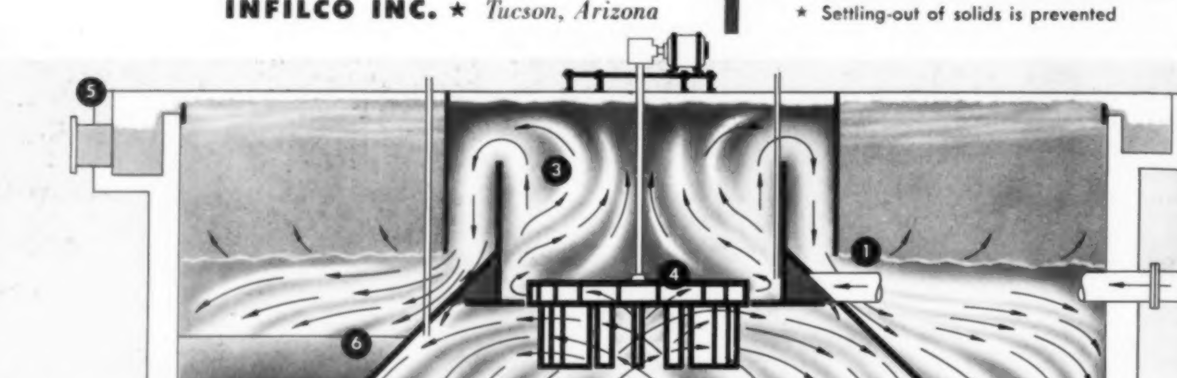
permits the treated water to separate from the top of a downward-moving pool of uniformly sized slurry in contrast to having the treated water filter upward through a suspension of sludge of gradually decreasing particle sizes.

INFILCO INC. ★ *Tucson, Arizona*

Outstanding advantages—based on more than two thousand Accelator efficiency-of-operation reports:

- ★ Faster separation of solids from treated water
- ★ Low-velocity movement of tremendous quantities prevents floc break-up
- ★ Rapid mixing of incoming water and chemically impregnated slurry
- ★ Small or large flows have complete contact with slurry
- ★ Thickened sludge is automatically drawn off
- ★ Settling-out of solids is prevented



"EXPLAIN-MORE" DIAGRAM

the Accelator basin contains:

1. A raw water inlet and distributing duct
2. A primary mixing and reaction zone
3. Two concentric draft tubes which form the secondary mixing and reaction zone
4. A rotor-impeller for mixing and pumping, driven by motorized reducer
5. An effluent launder system
6. Concentrators to accumulate and remove excess slurry

SUGGESTED ACCELATOR APPLICATIONS / POSSIBLE TREATMENT REQUIREMENTS → / WATER END-USE	SOFTENING	CLARIFICATION	STABILIZATION	ALKALINITY REDUCTION	ORGANIC MATTER REMOVAL	TASTE AND ODOR REMOVAL	COLOR REMOVAL	IRON REMOVAL	SILICA REDUCTION	NEUTRALIZATION
MUNICIPAL	x	x		x	x	x	x	x		
PULP	x	x		x	x		x	x		
PAPER	x	x		x	x		x	x		
BEVERAGES		x		x	x	x	x	x		
COOLANT	x	x	x	x	x			x		
BOILER FEED	x	x		x	x		x	x	x	
RAILROADS	x	x					x			
TEXTILE	x	x			x		x	x		
CANNERIES		x		x	x	x		x		
BREWERIES		x		x	x	x	x	x		
OIL FIELD FLOODING		x	x		x		x	x		
BRINE DISPOSAL		x	x		x		x	x		
INDUSTRIAL WASTES DISPOSAL AND REFUSE		x	x		x		x			x

John Howard Hickey (A.M. '36) civil and distribution engineer for the Elizabethtown Consolidated Gas Co., Elizabeth, N.J., died of a heart attack on April 15 while driving to work. He was 54. Mr. Hickey had been affiliated with the gas company since 1930. Prior to that he was employed as inspector and assistant engineer at Halifax, Nova Scotia, and then as assistant engineer with J. Wallace Higgins, of Roselle Park, N.J., in charge of municipal construction work. Mr. Hickey was an alumnus of Nova Scotia Technical College.

Fred Hornkohl (M. '41) of Lenapah, Okla., died some time ago, according to information recently received at Society headquarters. He was 57. After receiving a degree in architectural engineering from the University of Illinois, he was employed as a quantity surveyor by Fred Hornkohl, Jr., for two years, and as an architectural engineer with Charles W. Shaver, Salina, Kans., for two years. From 1926 to 1931 he was secretary-treasurer of the Masters Builders Association of Kansas, general contractors. He had also been superintendent in charge of construction at the University of Illinois, and associated with the Busboom & Rauh Construction Co., of Topeka, Kans.; the Fraser Brace Engineering Co., Inc.; and the Roane-Anderson-Co., of Oak Ridge, Tenn.

William Theodore Lyons (A.M. '32 president of the William T. Lyons Co., Inc., of Baltimore, Md., died on March 1, at the age of 48. Mr. Lyons was associated in various capacities with the firms of Geo. Colon & Co., John K. Turton & Co., R. W. Hebard & Co., and the Delta Construction Co., all of New York, from 1924 to 1931. Since 1931, he had been engaged in private practice and general contracting in New York City, Pennsylvania and Maryland.

William Gerrie Brown (M. '06) consulting engineer of Portland, Oreg., died several months ago according to information recently received at Society headquarters. He was 82 years old. At the outset of his career he held several positions with railroad companies; served as deputy city engineer of Oregon City; worked on the Cascade Locks, Oreg., in various capacities, for nine years; and was a member of the firm of Hegardt & Brown, Portland. For many years prior to his death he maintained his own consulting practice in Portland.

Andrew D. Schindler (M. '20) railway executive and founder and president of the Kings County Development Co., of San Francisco, Calif., died in that city on April 27. He was 89. On graduation from the University of California in 1882, he entered railroad work. In succession he was superintendent of the northern division of the Santa Fe Railroad, manager of the Huntington Railways of Los Angeles, and manager of the Sacramento Northern Railway. Mr. Schindler formed the Kings County Development Company, a real estate firm, in 1924, and was active in its management until his death.

(*Continued on page 88*)

Elmore Grigg Smith (M. '49) lieutenant colonel, U.S. Army, died March 13, on Formosa, where he was deputy chief of the combined service forces of the Military Assistance Advisory Group. He was 51 years old. Colonel Smith, who enlisted in the infantry in World War I at the age of 16, was a veteran of both World Wars. During the twenties and thirties he held engineering posts in the New York City administration, first with the Board of Estimate and later with the City Planning Commission. In 1948 he was recalled to duty as logistics adviser to the General Staff. Colonel Smith was an alumnus of Rensselaer Polytechnic Institute.

Allan Lamar Link (J.M. '51) a recent graduate of Texas Technological College, died last November. At the time of his death he was 25 years old, and living in Fort Worth, Tex. Mr. Link was employed as an engineer-in-training by J. J. Rady, of Fort Worth, Tex.

Harris Shell Bennett (A.M. '37) senior engineer in the U.S. Engineer Office at San Francisco, Calif., died recently. He was 49 years old. After graduating from Purdue University, Mr. Bennett was employed as a draftsman for the National Tube Co., at Gary, Ind., and was later connected with the municipal engineering department of Gary. He then engaged in the structural design of bridges, and served as engineer for the U.S. Forest Service, at Loogootee, Ind. Since 1935 he had been working in the U. S. Engineer Office, starting as associate engineer at Los Angeles.

Walter Ludlow Taylor (M. '20) retired engineer and architect of Lansdowne, Pa., died there on March 15. He was 76 years old. Before joining the Public Works Department, he was a draftsman and office engineer for several architects and engineers. From 1901 until his retirement in 1944, Mr. Taylor was an employee of the Fourth Naval District, at the Navy Yard, Philadelphia, Pa. He held the position of design superintendent for the district during the last 23 years of this period.

Hugh Ellmaker Hale (M. '20) consulting engineer for the Ralph C. Coxhead Corporation of New York and a railroad engineering specialist, died in New York, on April 21, at the age of 78. He had been a civil and consulting engineer for the Pennsylvania, the Baltimore & Ohio, and the Missouri Pacific Railroads, and later was vice-chairman of the Eastern Group of the Presidents' Conference Committee, Federal Valuation of Railroads in the United States. From 1936 to 1945 he was railroad engineer for the Equitable Life Assurance Society, New York. He was a graduate of Lehigh University, class of 1897.

[*Editor's Note:* Through an error that is much regretted the name of the late William L. Butcher, M. ASCE, was inserted in the obituary of Ernest Albert Cleveland, M. ASCE, which appeared in the May issue (page 86). Mr. Cleveland was chief commissioner of the Greater Vancouver Water District, Vancouver, B.C.]

NEWS OF ENGINEERS

David Bonner, vice-president of the Frederick Snare Corp., of New York, was elected president of The Moles, New York society of heavy construction men, at their recent annual meeting. Other officers elected include ASCE Past-President **Richard E. Dougherty,** first vice-president; **George F. Ferris,** second vice-president; **Charles E. Simmons,** sergeant - at - arms; **Harry T. Immerman,** secretary; and **Howard P. Maxton,** treasurer. New trustees are **Peter F. Connolly, Andrew Fischer, Jr., Eugene G. Rau, James G. Tripp,** and **Edward P. Palmer.**


David Bonner

Herman G. Baity, head of the department of sanitary engineering, University of North Carolina, has accepted directorship of the newly established Division of Environmental Sanitation of the World Organization for one year.

Robert F. Blanks, vice-president and general manager of Great Western Aggregates, Inc., a subsidiary of the Ideal Cement Company of Denver, Colo., has also been named research consultant to the Ideal Cement Company.

Karl R. Kennison, consulting civil and hydraulic engineer, and former chief engineer of the Metropolitan District Water Supply Commission, Commonwealth of Massachusetts at Boston, has been named chief engineer of the New York Board of Water Supply. He succeeds the late **John M. Fitzgerald.**

Miles I. Killmer, vice-president and general manager of Mason and Hanger Co., New York engineers and contractors, was one of five alumni recently honored by Pennsylvania State College "for distinguished achievement." Mr. Killmer is a leader in the field of tunnel construction and was a recent winner of the Moles' construction award.

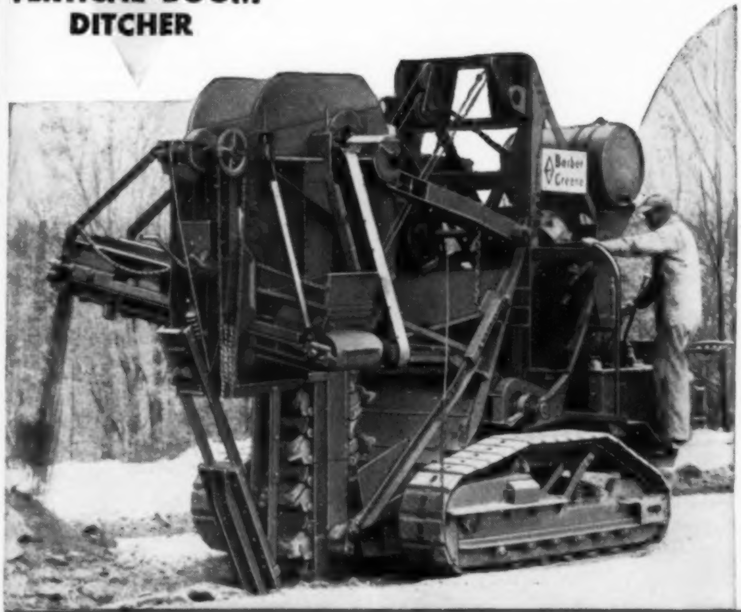
Frank A. Kittredge, chief engineer of the National Park Service, Washington, D. C., is retiring. He was chief engineer from the creation of the engineering division of the Service in 1927 to 1937, and since 1947. From 1937 to 1947, Mr. Kittredge served as director of Region 4, and superintendent of Grand Canyon and then Yosemite National Park.

(Continued on page 92)

BARBER-GREENE HEAVY DUTY DITCHER

MODEL
44-C
VERTICAL BOOM DITCHER

for lowest cost per foot of trench in all weather



SAVE ON JOBS LIKE THESE:

Highway Widening
Sewer, Water and Gas Distribution
Pipe Line Construction
Airport Drainage
Uncovering Joints
Placing Conduit Tile
Building Foundations
Farm Tiling
Grave Digging

DIGS CLEAN . . . **leaves vertical walls . . . square cuts . . . eliminates most expensive handwork.**

MILLING ACTION . . . **closely spaced buckets pare small increments as a milling machine cuts metal.**

OVERLOAD RELEASE . . . **slips when overload occurs . . . automatically re-sets itself . . . no down time for replacing shear bolts, etc.**

Only Barber-Greene offers so many proved ditcher advantages to save time and money on all trenching operations. For instance, the Vertical Boom means a compact, easily maneuvered machine: digs straight down, right up to walks, foundations, underground pipes, etc. . . . digs *all* the ditch . . . no expensive handwork required. The Vertical Boom stays *down* — the harder the digging, the harder the buckets hold it down. Cuts trench to 8'-3" depth, 24" wide.

Self-cleaning "kick-out" buckets operate in a vertical plane . . . produce the famous B-G milling action that cuts through coral, frozen ground, caliche and other formations that completely stop other ditchers.

Another time- and money-saving feature is the exclusive B-G overload release that slips on overload and automatically resets itself until the obstruction is removed or the operator stops machine—and then it re-sets itself for continued operation, protecting machine, hidden mains, cables, etc.

Plan to put the advantages of the B-G Model 44-C to work for you.

Barber-Greene

AURORA, ILLINOIS, U.S.A.

Frederick Ohrt

Frederick Ohrt, for 27 years manager and chief engineer of the Board of Water Supply for the city and county of Honolulu, Hawaii, has retired to give full time to his responsibilities as a trustee of the Estate of James Campbell, one of the largest land-owners in the territory. Mr. Ohrt was elected an Honorary Member of ASCE in 1951. **Edward J. Morgan,** who has been associated with the board for 20 years, has been named to succeed him.

Willard D. Lavers of Oak Ridge, Tenn., is now associated with Ebasco Services Inc., in New York City. **Logan B. Emlet** takes over Mr. Lavers' post as superintendent of the Y-12 plant of the Oak Ridge National Laboratory.

Grant E. Meyer, federal aid inspecting engineer and district materials engineer, U.S. Bureau of Public Roads, at Missoula, Mont., has been transferred to Addis Ababa, Ethiopia. He is serving as division materials engineers of the Ethiopia Division of the Bureau.

Nelson F. Pitts, Jr., was honored recently for his 38 years of service as city engineer of Syracuse, by a resolution of the Common Council of Syracuse.

William E. Grove, Jr., of Toledo, Ohio, is now resident field engineer for the new "twin" grinding and polishing unit at the Rossford plant of Libbey-Owens-Ford Glass Company. He was formerly assistant maintenance engineer.

Joseph I. Gurfein, lieutenant colonel, U.S. Army, who recently returned from 17 months service in Korea, succeeds **Lt. Col. William H. H. Mullin** as executive officer in the Philadelphia District, Army Corps of Engineers.

The firm of **Charles A. Haskins,** consulting sanitary and hydraulic engineers, of Kansas City, Mo., announces that **William G. Riddle** is now associated with the firm. Previously Mr. Riddle was senior engineer for the Burns & McDonnell Engineering Co., of Kansas City, Mo.

Earl R. Huber has been appointed Regional Engineer for Region 3 of the U.S. Forest Service, succeeding **Howard Waha,** who is retiring after many years in the Service. Region 3 includes the national forests of Arizona and New Mexico, with headquarters at Albuquerque, N. Mex.

Emile Husar succeeds **Clyde M. Pratt** in the capacity of chief borough engineer for Leonia, N.J. Mr. Pratt is retiring after more than 16 years in municipal service.

William S. Burks, Jr., lieutenant commander, U.S. Navy, has been recalled to active duty with the Civil Engineer Corps. As in World War II, he is on leave of absence from the Army Corps of Engineers, Mobile District.

Daniel C. Drucker, professor of engineering at Brown University, Providence, R.I., has been awarded a $10,000 National Science Foundation basic research grant for a two-year project entitled "Research in Three Dimensional Photoelastic Techniques."

Rolf Eliassen has been designated by the Department of State as engineer member of the U.S. Delegation to the Fifth World Health Assembly meeting in Switzerland. Dr. Eliassen is on leave of absence from his position as professor of sanitary engineering and director of the Sedgwick Laboratories of Sanitary Science at the Massachusetts Institute of Technology.

Robert Patterson Kline, colonel, Corps of Engineers, recently in charge of military construction at Fort Ritchie, Md., is now Chicago district engineer, for the Corps.

T. William Lambe, of Cambridge, Mass., has been promoted from the rank of assistant professor to associate professor in the department of civil and sanitary engineering at the Massachusetts Institute of Technology.

John O. Eichler, professor of civil engineering at the Cooper Union School of Engineering, New York, is head of the newly formed Metropolitan New York Section of the American Society of Photogrammetry. Professor Eichler was one of the organizers of the section.

Francis S. Friel, president of Albright & Friel Inc., consulting engineers of Philadelphia, Pa., has just been appointed a member of the State Registration Board for Professional Engineers. Mr. Friel, who is ASCE Director representing District 4, was also recently named a member of the United States Executive Committee of the International Commission on Large Dams.

Herbert S. Gladfelter, has retired from his position as engineer in charge of the mechanical and electrical section of the Engineering Division, Memphis District of the U.S. Engineers after 42 years of service. He is now engaged in private consulting practice specializing in mechanical and marine engineering, at Memphis.

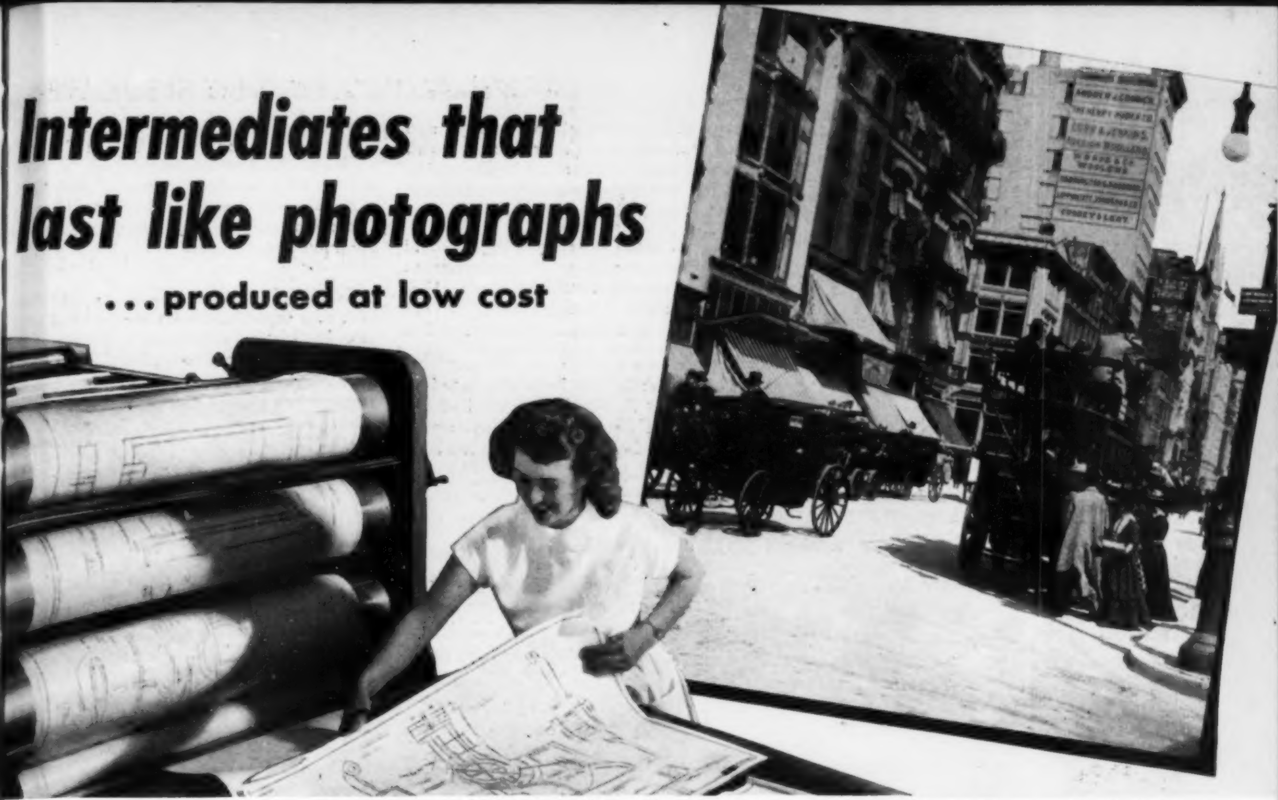
John D. Hartup, Jr., first lieutenant, U.S. Army, was recently the top graduate of the Army's Stevedore Supervisor School at Kobe, Japan.

Richard V. Jackson, civil engineer connected with the Morrison-Knudsen Co., in Fairbanks, Alaska, has been transferred to a subsidiary group, Morrison-Knudsen de Venezuela to take part in the construction of the Boqueron Tunnels in Venezuela.

(*Continued on page 96*)

Intermediates that last like photographs

. . . produced at low cost



A case history based on the experience of the Hyster Company, Portland, Oregon

By reproducing its engineering drawings on Kodagraph Autopositive Paper, the Hyster Company gets intermediates which have dense black photographic lines on a translucent, highly durable paper base. *Intermediates* which will remain intact in the files year after year . . . and produce sharp, legible blueprints and direct-process prints whenever needed.

And the cost is surprisingly low because Kodagraph Autopositive Paper boasts unique photographic properties which cut production costs *substantially*. It can be handled in ordinary room light . . . and it produces positive copies *directly*—without a negative step.

Furthermore, existing equipment can be utilized—Autopositive can be exposed in any blueprint or direct-process machine . . . and processed in standard photographic solutions. Hyster uses a blueprint machine which has also been designed to produce Autopositive intermediates in a continuous flow.

How The Hyster Company Uses Autopositive

For All Print Production. Autopositive intermediates are used instead of valuable and perishable original drawings. Producing sharp, legible blueprints and direct-process prints time after time, they greatly reduce the possibility of reading errors in the shop.

For "Permanent" Files in its home office . . and branches in the United States and abroad. "Photolasting" Autopositive intermediates eliminate the costly delays experienced in the past when intermediates faded, turned yellow, or became brittle.

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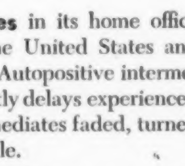
"THE BIG NEW PLUS" in engineering drawing reproduction



Learn in detail all the ways you can use Kodagraph Autopositive Paper — the revolutionary photographic intermediate material which you, or your local blueprinter, can process *quickly . . . economically . . . at a low cost.*

EASTMAN KODAK COMPANY
Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a copy of "New Short Cuts and Savings" . . . describing the many savings Kodagraph Autopositive Paper is bringing to industry.

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Company__________

Street__________

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Kodak
TRADE-MARK

Ernest A. Moritz, regional director of the U.S. Bureau of Reclamation, recently received the Department of the Interior's highest honor, the Distinguished Service Award, for "an eminent career of 31 years in government service." Mr. Moritz is director of Region 3, with headquarters at Boulder City, Nev.

Ernest A. Moritz

John B. Stirling, of Montreal, Canada, has been named honorary colonel of the 3rd Field Engineer Regiment of Montreal.

Joseph B. Diamond, attorney at law and licensed professional engineer, formerly with Bleakley, Platt, Gilchrist and Walker, New York City, is now engaged in the practice of law at the Bar Building in New York City.

Charles S. Duke has retired from federal service after completion of two overseas assignments as construction engineer, U.S. General Services Administration, in the Virgin Islands, and Cuba during the last five years.

Walter H. Price has been appointed to succeed **Robert F. Blanks,** as head of the U.S. Bureau of Reclamation's Engineering Laboratories in Denver, Colo. He has been a staff member of the laboratories since 1934.

James E. Reeves, veteran of 22 years service with the Army Corps of Engineers, is now deputy director of the Atomic Energy Commission's Office of Test Operations in Albuquerque, N. Mex.

Edward J. Scullen announces formation of a new organization for engineering practice, in association with **A. J. Scullen,** with headquarters in Bethesda, Md. Mr. Scullen was previously assistant professor of civil engineering at the Catholic University of America.

William H. Sprang, formerly employed by the Illinois Division of Highways as associate editor of *Illinois Highways,* has joined the Universal Pipe Co., as sales engineer at Pittsburgh, Pa.

George P. Steinmetz, chief engineer of the Wisconsin Public Service Commission, Madison, Wis., and **Robert C. Johnson,** president of the Siesel Construction Co., Milwaukee, Wis., recently received distinguished service citations for outstanding service in their field, from the University of Wisconsin.

Leif John Sverdrup, head of the consulting engineering firm of Sverdrup and Parcel, St. Louis, Mo., has been awarded an honorary degree by the University of Missouri.

Isaac Newton Vaughan III, second lieutenant, 2d Engineer Special Brigade in Japan, was recently transferred for reassignment in the Far East Command. Before his transfer, he served as aide-de-camp to **Brig. Gen. Walter D. Luplow,** commander of the brigade.

Henry Walsh, colonel, Corps of Engineers and district engineer at Nashville, Tenn., has been assigned to San Francisco, replacing **Col. Kenneth M. Moore,** as District Engineer there. **Col. Robert W. Lockridge** will be Acting District Engineer at Nashville pending appointment of a new head.

A. Carl Weber, director of research and engineering sales for the Laclede Steel Co., St. Louis, Mo., was elected president of the Steel Joist Institute at a recent meeting in White Sulpher Springs. **Prof. J. W. Hubler,** chairman of the department of civil engineering at Washington University, was reappointed consulting engineer for the Institute.

Fred R. White, chief engineer, Iowa Highway Commission for 33 years, has resigned effective September 1. After his retirement he will serve as consultant to the Commission.

Leslie Williams, traffic engineer and city planner for the Automobile Club of New York, has accepted the appointment of deputy commissioner of the newly created Department of Streets of the City of Philadelphia.

William S. Wise, chief engineer of the Connecticut State Water Commission since 1942, was promoted to the post of commission director recently vacated by **Richard Martin,**

Harvey Hicks Allen, former director of public works and city manager of Corpus Christi, Tex., has been designated vice-president of the Featherlite Corp., of Dallas, Tex. He has been serving as general superintendent of Byrd-Frost, Inc., at Dallas.

Duncan Campbell was recently appointed to the Construction Industry Stabilization Board. Prior to that he had served as mediator with the Public Works Administration and Federal Works Agency.

David W. Heiman, colonel, U. S. Army, who has been serving as chief, Engineer Supply Control Office, Office of the Chief Engineer, relieves **Rear Admiral J. W. Fowler,** U.S. Navy, of the position of Director of the Munitions Board Cataloging Agency, at Washington, D.C.

Don H. Bushnell, chief engineering appraiser, Farm Credit Administration, at Washington, D.C., received a Superior Service Award at the recent annual awards ceremonies of the U.S. Department of Agriculture. Mr. Bushnell's citation was "for exceptional planning, organizing and leadership ability; and the effective development of the engineering appraiser organizations in the Federal land bank system."

John P. Riley, coordinator of School Construction for New York City's Board of Education, has been elected an honorary member of the American Institute of Architects. This distinction, which honors non-members of the Institute, will be conferred on Mr. Riley on June 24 at an exhibit and celebration to mark the Re-Union of Architecture and Engineering to be held in the recently completed Lever House Building in New York.

Howard P. Maxton is now associating himself with the De Long Engineering Construction Co., of New York City. Until recently he was secretary and assistant treasurer of the Raymond Concrete Pile Co., of the same city.

Solution to problem on page 58

Exposed to the southwestern sun, the pipe was heated many degrees each day and expanded down the mountain side along the line of least resistance. Then, when the pipe cooled in the evening, it contracted in the same direction, that is, downhill.

New Publications

Concrete. An abstract of modern knowledge in the field of making concrete is offered in question-and-answer form by the American Concrete Institute. The author is F. R. McMillan, director of research for the Portland Cement Association. The 46-page pamphlet entitled, *Concrete Primer*, may be purchased from the American Concrete Institute, 18263 West McNichols Road, Detroit 19, Mich., at 35 cents a copy.

Steel Products. Continuing the revision of its *Steel Products Manual*, the American Iron and Steel Institute has made available three new publications. They are Section 4, entitled "Carbon Steel Structural Sections and Steel Sheet Piling"; Section 6 on "Carbon Steel Plates and Rolled Floor Plates"; and Section 7 covering "Alloy Steel Plates." They may be ordered from the Institute, 350 Fifth Avenue, New York 1, N.Y., at 25 cents each.

Welding. Welding procedure in the United States forms the basis of a recent report of the Anglo-American Council on Productivity, detailing the observations of a specialist team that visited the United States in 1950. It is the consensus of the team that, although British welding standards are the equal of those in the United States, the applications of many features of American practice to British industry would have a beneficial effect on productivity. Inquiries concerning the publication, which is priced at 3s 6d, may be addressed to the U.S. section of the Council at 2 Park Avenue, New York 16, N.Y.

(*Continued on page 100*)

call this pipe

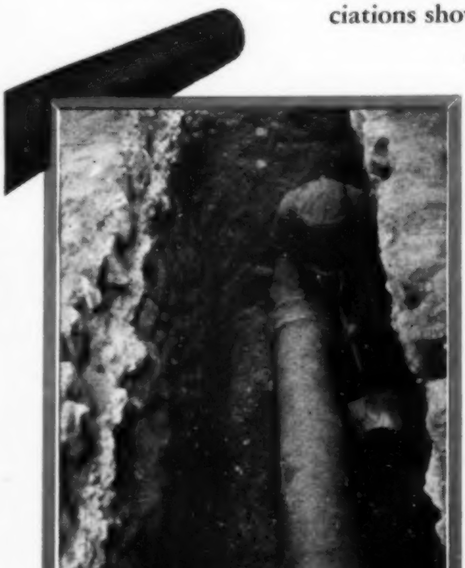
*America's No.1 Tax Saver

Top Tax Saver is the cast iron pipe in the water distribution systems of cities and towns throughout America. Beyond question, long-lived cast iron pipe has saved, and today is saving taxpayers millions of dollars. Why?

An estimated 60% of the $6-billion cumulative investment in America's water supply systems is represented by pipe and labor for the construction of supply and distribution mains, paid for usually by the issuance of bonds.

Leading waterworks engineers estimate the useful life of cast iron pipe at *4 to 5 times* the average term of a water revenue bond issue. They base their estimates on the fact that over 35 American cities have cast iron mains in service that were installed more than 100 years ago. Moreover, a survey sponsored by three waterworks associations shows that 96% of all six-inch and larger cast iron pipe *ever laid* in 25 typical cities, are still in service. Thus, the *strength factors* of long life, native to cast iron pipe, are self-evident.

When you consider that over 95% of America's water distribution systems are constructed with long-lived cast iron pipe, can you doubt that it is *America's No. 1 Tax Saver?*



America's oldest functioning water main is in its 135th year of service in Philadelphia's distribution system. Cast iron, of course. Over 30 other cities have century-old cast iron mains in service.

CAST IRON ®

CAST IRON PIPE

America's No.1 Tax Saver

CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

(*Continued from page 97*)

Blueprint Reading. A basic course in interpreting blueprints, trade sketches, and specifications has been developed for all branches of the building trades by the Connecticut State Department of Education and Delmar Publishers. Planned to meet specific teaching requirements, the 193-page illustrated book is divided into three major sections. Part I includes a series of instructional units on the principles of interpreting trade blueprints; Part II deals with trade sketching procedures and practices; and Part III makes practical applications of blueprint-reading principles. Plastic-bound copies sell for $3.25, and cloth-bound copies for $4.25. Inquiries should be addressed to Delmar Publishers, 650 Broadway, Albany 1, N.Y.

Column Research. A report on the origin and progress of current research projects of the Column Research Council, covering the period 1944–1951, has been issued as CRC Bulletin No. 1 of the Engineering Foundation. Formally organized in 1944 for study of structural behavior involving compression elements and the properties of metallic materials available for their construction, the Column Research Council now has 26 participating organizations. Bulletin No. 1 was prepared by Bruce G. Johnston, M. ASCE, chairman of the former Committee on Research of the Column Research Council. A limited number of free copies is available from Lynn Beedle, Secretary, Column Research Council, Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa.

Frost Action. A comprehensive review of the voluminous literature on the subject of frost action in roads and airfields has been issued as Special Report No. 1 of the Highway Research Board. Prepared by A. W. Johnson, A.M. ASCE, engineer of soils and foundations for the Board, the report summarizes the writings in the field in chronological order, complementing the symposium on frost heave and action in soil presented at the 1951 annual meeting of the Board. Information on regulation of loads is omitted because that phase of the frost problem is under study by another committee of the Board. Special Report No. 1 may be purchased from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C., at $3 a copy.

Hydraulic Research. Data outlining the current status of hydraulic research in the United States have been assembled from hydraulic and hydrologic laboratories here and in Canada by the National Bureau of Standards and issued as Miscellaneous Publication No. 201. Copies of the 190-page publication are available from the Government Printing Office, Washington 25, D.C., at $1.25 each.

Linear Scale Slide Rules. Numerous mathematical problems can be solved quickly, accurately and easily with a linear slide rule by methods discussed by Morris L. Groder, electronic engineer for the U.S. Navy, in a 64-page bulletin entitled *Linear Scale Non-Logarithmic Slide Rules.* The principles described are presented as tools for constructing general, special, and emergency slide rules. Copies are available from the publisher, the C & G Corporation, 2003, East 12th Street, Brooklyn 29, N.Y., at $2.98 each.

Exposure-Test Wall. A long-range project of the National Bureau of Standards to study the action of various weathering agents on a stone exposure-test wall is discussed in U.S. Department of Commerce Building Materials and Structures Report 125. The study, which is expected to aid in developing more reliable laboratory methods for predicting durability, is a cooperative investigation of the National Bureau of Standards and Committee C-18 of the American Society for Testing Materials (January 1950 issue, page 78). Detailed reports on the various materials will be issued later as weathering data become more apparent. Copies of Report 125 may be obtained from the Government Printing Office, Washington 25, D.C., at 30 cents each.

Accident Prevention. To further its safety program, the Associated General Contractors of America has made available 14 pocket-size reprints of some sections of its *Manual of Accident Prevention in Construction.* Designed for use on construction jobs, each of the 14 pamphlets contains one to six appropriately grouped sections of the original manual. The reprints are available from the Associated General Contractors of America Inc., Munsey Building, Washington 4, D.C.

Water Resources, Canada. Recent publications of the Water Resources Division of the Canadian Department of Resources and Development include Water Resources Paper No. 108, covering Atlantic drainage for the climatic years, 1948–1949 and 1949–1950, and Paper 101 reviewing Arctic and Western Hudson Bay drainage for the climatic years 1945–1946 and 1946–1947. Both reports may be obtained from the Water Resources Division, Department of Resources and Development, Ottawa. They sell for $1.50 and $3, respectively, with checks payable to the Receiver General of Canada.

Missouri Basin Development. A six-year program of the Missouri Basin Inter-Agency Committee for land and water resources development of the Missouri River Basin has been made available in a fourth revision dated October 1951. The program includes expenditures and estimated requirements for the six-year period, 1953–1958. Inquiries concerning the revised program should be addressed to the Missouri Basin Inter-Agency Committee, Federal Power Commission, 610 South Canal Street, Chicago 7, Ill.

Flood Routing. A simple and practical method of flood routing is described by Prof. V. T. Chow, A.M. ASCE, in a paper entitled "A Practical Procedure for Flood Routing." Reprints of the paper, issued as Hydraulic Engineering Series No. 1, Civil Engineering Studies, University of Illinois, are available without charge from the Department of Civil Engineering, University of Illinois, Urbana, Ill.

Mississippi Stages and Discharges. Issuance of a 340-page publication containing detailed Mississippi River stream-gaging records for 1950 is announced by the Mississippi River Commission. Entitled *Stages and Discharges, Mississippi River and Its Outlets and Tributaries, 1950*, the publication includes daily gage and river discharge records at stations operated by Corps of Engineers districts and other agencies. Copies may be purchased from the Office of the President, Mississippi River Commission, Vicksburg, Miss., at $1 each.

Measuring Equipment. With publication of *Testing of Measuring Equipment*, the National Bureau of Standards completes a series of four handbooks designed to assemble information on regulatory activities in the field of weights and measures. Identified as Handbook 45, the 205-page manual is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at $1.25.

Colorado River Drainage. Recommendations for pollution control in the Colorado River Drainage Basin are contained in a cooperative state-federal report on water pollution in the area, which is one of a series on the major drainage basins of the country being prepared under authority of the Water Pollution Control Act of 1948. Inquiries concerning the report, which is identified as Public Health Service Publication No. 110, may be obtained from the Western Gulf and Colorado Basin Office of the Public Health Service, 201 Norman Building, Dallas, Tex.

Joint Ventures. An article dealing with the joint venture in business, originally published in the *Virginia Law Review*, has been made available in reprint form by the Surety Association of America, 60 John Street, New York 38, N. Y. The author is Henry W. Nichols. Also available from the Association is a reprint of a paper by Edward H. Cushman, Philadelphia attorney, entitled "Credit Factors in Construction"—delivered at the annual meeting of the National Association of Surety Bond Producers, held in Texas in March 1951.

Radioactive Materials. Publication of the Proceedings of its recent research correlation conference on laboratory design for handling radioactive materials is announced by the Building Research Advisory Board. Sponsored by the American Institute of Architects and the Atomic Energy Commission, the conference was the first to meet the growing need of architects and engineers for design criteria in the field. The 140-page illustrated volume will go without cost to those who attended the conference and paid the registration fee. Others should address their inquiries to the Building Research Advisory Board, 2101 Constitution Avenue, Washington, D.C.

Exposure Tests of Building Materials. Tests conducted by the National Bureau of Standards to determine the resistance of nailed sheet-metal building materials to atmospheric corrosion and to show that improper installation practices can cause serious corrosion are reported in a recent 24-page bulletin, prepared by Theodore H. Orem. Two-year exposure tests were made on metallic building sheets of aluminum, aluminum alloy, aluminum-coated steel, galvanized steel, and zinc alloy. Copies of the bulletin may be ordered from the Government Printing Office, Washington 25, D.C., at 20 cents each.

Land Subdivision. A booklet designed to assist developers and local public officials in providing subdivision practices that will promote sound community development has just been published by the Housing and Home Finance Agency. Entitled *Suggested Land Subdivision Regulations*, the publication includes definitions, procedures, design standards, required improvements, plats and data, variances, and allied requirements. Copies are available from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at 45 cents each.

Soil Stabilization. An article on the electro-osmotic stabilization of soils by Leo Casagrande, M. ASCE reprinted from the *Journal of the Boston Society of Civil Engineers*, constitutes Harvard Soil Mechanics Series No. 38. The study is divided into three parts, the first discussing the principles of electro-osmotic flow through capillaries, the second describing phenomena resulting from application of electro-osmosis to compressible, fine-grained materials, and the third presenting practical applications in earthwork and foundation engineering. Inquiries should be addressed to the Harvard Soil Mechanics Series, Pierce Hall, Harvard University, Cambridge, Mass.

Cement Bibliography. Publication of a 491-page comprehensive bibliography on cement and concrete for the period, 1925–1947, is announced by the Engineering Experiment Station of Purdue University. The lithoprinted, plastic-bound book contains a subject and author index, and a total of over 40,000 references. Priced at $5.00, it may be obtained from the Director, Engineering Experiment Station, Purdue University, Lafayette, Ind.

Area Triangulation. The principal revision in the new edition of the *Manual of Reconnaissance for Triangulation*, issued by the Coast and Geodetic Survey, is in the design and plans for schemes of area triangulation. The manual, identified as Special Publication No. 225, details principles of reconnaissance and provides some typical examples of the operations involved. Copies may be purchased from the Government Printing Office, Washington 25, D.C., at 30 cents apiece.

Universities and Colleges. Availability of the sixth edition of *American Universities and Colleges*, a standard reference volume on higher education since 1928, is announced by the American Council on Education. Inquiries concerning the 1,100-page volume, which is priced at $10, should be sent to the American Council on Education, Washington 25, D.C.

Soil Measurements. Nuclear meters for measuring density and moisture of the surface layer of soils are discussed in Technical Development Report No. 161 of the Civil Aeronautics Administration. The authors are D. J. Belcher, A. M. ASCE, T. R. Cuykendall, and H. S. Sack, of Cornell University. Inquiries should be addressed to the CAA Technical Development and Evaluation Center, Indianapolis, Ind.

Sedimentation and Erosion. A 22-page illustrated report outlining the relation of sedimentation to accelerated erosion in the Missouri River Basin has been made available as Technical Paper 102 of the Soil Conservation Service. Further information on this mimeographed report may be obtained from the author, Louis M. Glymph, Jr., who is Project Supervisor in the Office of Research, Sedimentation Section, Soil Conservation Service, Lincoln, Nebr.

Rubber Roads. The Natural Rubber Bureau Laboratory has published a second edition of *Stretching Highway Dollars with Rubber Roads*, including data on test strips of rubber roads laid during 1950. The illustrated pamphlet may be obtained from S. Ralph Dubrowin, The Natural Rubber Bureau, 163 K Street, N.W., Washington, D.C.

Applications for Admission to ASCE, April 12–May 10

Applying for Member

Harold Leverne Aitken, Lincoln, Nebr.
William Davidson Alexander III, Raleigh, N.C.
Grant Sherman Anderson, Los Angeles, Calif.
Adair Charles Barlow, Wilmington, Del.
Paul Asa Clark, Atlanta, Ga.
Allan Reginald Cullimore, Newark, N.J.
Arthur Eli Darlow, Miami, Fla.
John Sarkes Davagian, Cambridge, Mass.
Andrew Walter Day, Vincennes, Ind.
Edward John Donnelly, Baltimore, Md.
William Henry Ellison, San Francisco, Calif.
James Franklin Field, Juneau, Alaska.
Willis George Fish, Kansas City, Mo.
Harry Earl Fisher, Washington, D.C.
Joseph Mickle Fox, Philadelphia, Pa.
Irving Phillips Gould, New York, N.Y.
James Otis Granum, Washington, D.C.
Junius Edward Griffith, Knoxville, Tenn.
Harold John Hamilton, East Hartford, Conn.
Royce Bernard Hansen, St. Paul, Minn.
Frank Joseph Hebda, Chicago, Ill.
John Leslie Hill, Antofagasta, Chile.
Tim Ho, Honolulu, Hawaii.
William Matthew Jaekle, San Francisco, Calif.
William Hudson Lang, St. Paul, Minn.

Anthony George Lee, Indianapolis, Ind.
John Edward Linden, Chicago, Ill.
James Herty Lucas, Atlanta, Ga.
Edward Joseph Morgan, Honolulu, Hawaii.
Harvey Chester Olander, Denver, Colo.
Howard Evans Reid, New York, N.Y.
Kazys Rimkus, Dover, Del.
Donald Many Robinson, Denver, Colo.
Erwin Joseph Roesel, St. Louis, Mo.
John Nicholas Semevsky, Johannesburg, South Africa.
Aubrey Lee Sharp, Portland, Oreg.
Charles Rogers Shupe, Chicago, Ill.
Frederick James Thompson, Jr., Hartford, Conn.
Clarence Seth Wilcox, Casablanca, French Morocco.
James Baker Wilson, Honolulu, Hawaii.
Vance Vernon Wilson, Miami, Fla.
Fred K. Woolley, Fresno, Calif.
Jasper C. Womack, Sacramento, Calif.
Robert Higdon Young, Jackson, Miss.

Applying for Associate Member

Oscar Hunter Adams, San Antonio, Tex.
Richard Peter Askerman, Richland, Wash.
Frederick Amos Barnes, Los Angeles, Calif.
David Ira Bolden, Manhattan, Kans.
Thomas Chandler Bounds, Knoxville, Tenn.
Jose Candido Castro Parente Pessoa, Denver, Colo.
Michael Charles Daumit, Ellwood City, Pa.
Hsai-Yang Fang, Taiwan, China.
Harry Clinton Frankmann, Houston, Tex.
Kolar Narain Gopala Rao, Bangalore, India.
Peter Alfred Hakman, New York, N.Y.
William Anderson Hamilton, Jr., Dallas, Tex.
Daniel Michael Hegarty, New York, N.Y.
Sam Osamu Hirota, Honolulu, Hawaii.
Pesi Jijibhoy Jagus, Bombay, India.
Mahesh Chandra Johorey, Shahjahanpur, India.
Lee Roy Jones, El Paso, Tex.
Raye Charles King, Los Angeles, Calif.
Donald Keith Knight, Omaha, Nebr.
David Jordan Lewis, Portland, Oreg.
John Paul Lynch, Velasco, Tex.
Manojkumar Majumdar, West Bengal, India.
Candido Mena Marquez, Chicago, Ill.
Albert Vincent McEowen, Phoenix, Ariz.
Deric James McManus, Kent, England.
Lawrence Elwood Miller, Omaha, Nebr.
William Thompson Morrow, Dallas, Tex.
Stavros N. Niccolaou, St. Louis, Mo.
Yousif Nicola, Alexandria, Egypt.
Constantin Constantinovich Nizenkoff, Chicago, Ill.
John Frank Nolte, New Kensington, Pa.
Donnell Neel Oliver, San Francisco, Calif.
Pedro Juan Ortiz Santiago, San Juan, Puerto Rico.
Bhochana Panyadhibya, Yuma, Ariz.
Maurice Rapkin, San Francisco, Calif.
Nat Samuel Sachter, Denver, Colo.
Joaquim Laginha Serafim, Lisbon, Portugal.
Adam Morris Sharon, St. Louis, Mo.
Jocelyn Frederick Basil Shaw, Vancouver, B.C.
Per Dragheim Thorson, Wilmington, Del.
Richard Dana Wallace, Washington, D.C.
George Everett Wilbur, Phoenix, Ariz.
Alfonso Wilson, Jackson, Miss.
Raymond Donald Yusi, Walla Walla, Wash.

Applying for Junior Member

Mahdi Ali Al Kaem, Chicago, Ill.
Mustafa Kamil Avci, Casablanca, French Morocco.
Roger William Barbey, San Francisco, Calif.
Quentin Royal Bohne, St. Paul, Minn.
James Sterling Boyd, Lubbock, Tex.
Charles Frederick Buchanan, San Diego, Calif.
Ricardo Jose Casas, Santurce, Puerto Rico.
Paul Ear Chen, West Lafayette, Ind.
Fazal Ahmed Choudhury, Rochester, Pa.
George Lloyd Dill, Pine Bluff, Ark.
Warren Eugene Evans, Oakland, Calif.
Robert Franks, Philadelphia, Pa.
Kenneth Fred Gerleman, Chicago, Ill.
Stuart Jack Henderson, Seattle, Wash.
Harvey Benart Henry, Jr., Corpus Christi, Tex.
Ted Frank Jacobs, Baltimore, Md.
Howard Jacoby, New York, N.Y.
Joseph Nicefor Karwecki, Detroit, Mich.
Rajnikant Jayachand Kumbhani, Chicago, Ill.
James Wood Lambie, Boston, Mass.
John Allan Larson, Minneapolis, Minn.
Za-Lee Moh, West Lafayette, Ind.
John Norman Northup, Lawton, Okla.
Orlando Fidel Ray Rivero, Havana, Cuba.
Rafael Enrique Sarriera, San Juan, Puerto Rico.
Richard Chute Sharp, Gloversville, N.Y.
Penyamin B. Sogikoglu, Boston, Mass.
Carlos Alberto Sosa, Ancon, C.Z.
Lawrence Douglas Taylor, Oakland, Calif.
Sergio Luis Tello, New York, N. Y.
Elmer Leroy Van Tassel, Ramsey, N.J.
Luis Alfonso Vazquez-Agrait, San Juan, Puerto Rico.
Robert Cornelis Visser, Delft, Netherlands.
Warren Rendleman Webster, Louisville, Ky.
Albert Oscar Wilkat, St. Louis, Mo.

[Applications for Junior membership from ASCE Student Chapters are not listed.]

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Rear Dump Wagon

THE TR200, a hydraulically operated rear dump wagon, has been added to the company's line of earth moving equipment. The T200 two wheeled, rubber tired tractor that powers the wagon is the same tractor used with the TS200 motor scraper. It's available with a choice of diesel engines; one is a Cummins with 165 hp, and the other a Buda with 176 hp. Both are six cylinder engines. Scraper and wagon units are interchangeable. Each uses the same hydraulic system. One of the outstanding features of the unit is the stable wheel base. Four wheel air brakes make it possible to back the unit over the edge of a fill with complete safety. An obstruction-free body interior plus a 70 deg tilting angle assures the complete and easy discharge of all types of materials. The bottom of the body is of the double type construction, housing oak plank fillers to absorb loading shock. High-tensile steel is used for added strength and wearing quality. Top speed is 22 mph at a governed engine speed of 1800 rpm. **LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa.**

Interchangeable Scraper and Wagon Units

Drafting Machine Scales

A LINE OF STANDARD improved metal drafting machine scales marketed under the trade name "Duraline" is being introduced. The line consists of twelve standard types of graduations most used by civil, mechanical and electrical engineers, draftsmen and architects. Each style is available in 6, 12, 18 and 24-in. lengths. Duraline scales are made of an aluminum alloy, one of the most stable materials and one that possesses all the advantages of boxwood but that has none of the disadvantages. It will maintain its engine divided accuracy and hold a true smooth ruling edge. Uniformity of line length and depth of the large, easily read numerals are immediately apparent. The graduations do not extent to the drawing edge—consequently with no "file teeth" to act on the pencil point, graphite smears are eliminated and drawing stays clean. **Universal Drafting Machine Corp., 7960 Lorain Ave., Cleveland, Ohio.**

Vacuum Deaerator

THE VACUUM DEAERATOR, recently marketed, is engineered to a high degree of efficiency. The unit removes oxygen and free carbon dioxide from the water so as to protect piping, steel tanks and other equipment from the harmful effects of corrosion. The most frequently used method of deaeration for steam boilers is to raise the temperature of the water to the boiling point to make all gases insoluble and to scrub the boiling water with fresh steam. However, if the water is to be used cold, it is more practical to lower the boiling point by carrying out the process under vacuum in the Permutit vacuum deaerator. It is used for a variety of purposes, such as removing oxygen and carbon dioxide from surface water supplies which may be pumped great distances to point of use. In operation, water is sprayed into the deaerator shell maintained under a vacuum or at an absolute pressure approximating the boiling point. Pressure in the unit is held at vacua of 29.75 in. with respect to a 30 in. barometer when deaerating water at 40 or 50 deg F, respectively.

Special Water Conditioning Unit

The entering water is distributed over the top surface of a stack of trays or other packing such as Raschig rings. This packing sub-divides the water particles repeatedly to expose new water surfaces to the gaseous phase. The non-condensable gases and water vapor are then drawn upwards through the packing and removed by vacuum pumps or steam ejectors. This continual removal of gases scrubs the oxygen and carbon dioxide from the surface of the water and produces a higher partial vapor pressure in the lower part of the packing. The higher the partial vapor pressure the lower will be the oxygen and carbon dioxide partial pressure and therefore, the less will be their solubility. **The Permutit Company, 330 West 42nd St., New York 36, N. Y.**

Skid-Shovel

A LINE OF SKID-SHOVELS, built exclusively for International tractors in these models and capacities: TD-9, 1¼ yds; TD-14A, 2 yds; and TD-18A, 3 yds; are now in production. The skid-shovel has the cleanest design ever seen on heavy equipment. There are no hoses or pipes cluttered around the operator. All

Features Hydro-Spring

hydraulics are fully enclosed and protected. The rear end is free for mounting auxiliary equipment and low overall clearance permits work in confined areas. A patented feature called break-cut action gives the bucket a crowding action at every bite, assuring a heaped load from any cut. The bucket is rolled back as much as 28 in. before the load is lifted, and that extra yardage does not slip off the heap. The force of this prying action is transmitted through the loader shoes into the ground—not into the tractor. Another feature, which is standard equipment on the skid-shovel, is the hydro-spring. A pressure line running from the main lift rams to the hydro-spring, puts the hydraulic system under spring tension and reduces hydraulic shocks by two-thirds. This reduces wear and tear on the tractor and lowers maintenance cost. The skid-shovel has higher lift and farther pitch than any other loader in the same capacity range. **Drott Manufacturing Corp., Milwaukee 12, Wis.**

Plaster and Mortar Mixer

A PLASTER AND MORTAR mixer, 6 cu ft capacity, known as Model 80 is announced. Among the improved features of this machine is the everlasting shaft seal, which replaces the conventional stuffing boxes and packing. The seal not only reduces friction loss but it also alleviates wear on the paddle shaft. As a result of extreme field tests, the company guarantees the seal against replacement during the entire life of the mixer. Power is optional with 4.5 hp or 7.7 hp Briggs and Stratton air cooled engines or 3 hp electric motor. **Muller Machinery Company, Inc., Metuchen, N. J.**

Equipment, Materials & Methods (Continued)

Hydraulic Cable Reel Trailers

THE HYDRAULIC CABLE reel trailer, fully tested with experimental and development work completed, is now offered. One man can load full reels of cable without using wheel chocks or winch line. A tilting trailer is not necessary. Hydraulic carrier arms also may be utilized for other work such as lifting and transporting transformers or pulling poles, or any similar work within the capacity of the hydraulic equipment. A landing wheel replaces the usual landing stand. This allows the empty trailer to be wheeled into locations where tilt type trailers could not be placed. The load center of the loaded trailer is always forward of the axle. This makes it practically impossible to overturn the loaded trailer to the rear—an added safety feature. **The United Transportation Equipment Corporation, 752 Chestnut St., Redwood City, Calif.**

Portable Air Compressor

A 600 CU FT portable air compressor has been added to the company's line. The compressor has been designed from the ground up for 600 ft capacity. A rugged undercarriage provides the stamina required for moving the machine over rough terrain to location on construction projects. The engine was selected to provide reserve power at moderate operating speeds. The compressor is an 8 and $6^1/_2 \times 6$; operates at 1200 rpm; and is designed with large valve areas, large radius air passages, and carefully engineered ratio of low pressure to high pressure cylinders—features which are said to provide the rated 600 cu ft capacity with good compression efficiency. Like other Gardner-Denver portables, the 600 is a two-stage machine, with water-cooled compressor cylinders. **Gardner-Denver, Quincy, Ill.**

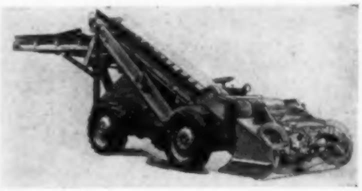
Designed for 600 ft Capacity

When Requesting Product Information Please Mention Civil Engineering

Equipment, Materials & Methods (Continued)

Stockpile-Windrow Loader

A STOCKPILE-WINDROW loader designated as the Force-Feed HiLoader, has been announced. One of the outstanding features is the Athey full floating feeder. The feeder is suspended from two coil springs and a pivot, allowing the paddle blades to "float" over the contours of the windrow. The HiLoader has an auger gather-feeder



HiLoader

that speeds up loading from stockpiles and wide windrows. The spiral blades extend to the moldboards of the gather and keep a steady flow of materials feeding inward to the paddle blades. The 30 in. conveyor belt of the loader is cleated to handle snow, sand and other light materials as well as heavier earth, dirt, rock and the like. A swiveling discharge conveyor is another feature of the HiLoader. The conveyor can be directed 45 deg right or left of center and is controlled hydraulically from the operator's seat. A Ford, 95 hp, 6-cylinder engine powers the versatile unit which can travel at speeds up to 19 mph. Loading speeds range through four gears from 0.3 to 1.92 mph. A short wheelbase makes the machine extremely maneuverable. The entire unit is only 34 ft, 7 in. long. Larger tires have been used to increase traction and flotation. The HiLoader is capable of loading up to 25 cu yds a min. in snow and up to 10 cu yds a min. in other materials, depending upon the material. **Athey Products Corporation, 5631 West 65th St., Chicago 38, Ill.**

Pump

A PUMP THAT readily transfers products which up till now have been considered difficult or impossible to pump, has been developed. Pumping action is accomplished by two fluid pistons. The Hydrex pump is designed to handle slurries, very viscous pastes, abrasive or corrosive fluids, and suspended solids without damage to the pump. Where contact between the pumping medium and the product must be avoided a suitable membrane is provided. Simple and sanitary, there are no bearings, mechanical pistons, packing glands, valves or impellers in the cylinders. **Manton-Gaulin Manufacturing Company, 65 Garden St., Everett 49, Mass.**

Equipment, Materials & Methods (Continued)

Trench-Hoe Boom

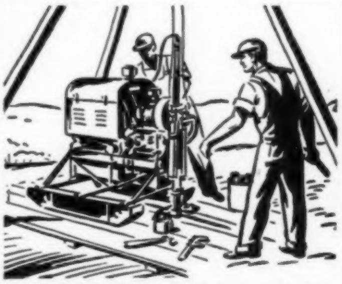
A HEAVY-DUTY, camel-back boom has been designed for use with all models of the Wayne Crane excavators. The boom will increase the reach of the 1/2 yd crawler, Model 66, to 26 ft 3 in. at grade level, and allow a digging depth of 17 ft 3 in.

Designed For Heavy Duty

The camel-back feature permits the operator to make a clean-cut vertical backwell to maximum depth. It also increases overall operating efficiency, gives greater dumping height and reduces spill-over. Conventional reeving through large interchangeable sheaves eliminates reverse cable bend, thereby minimizing cable wear, and simplifies attachment change-over. **Wayne-Crane Div., American Steel Dredge Company, Inc., Fort Wayne, Ind.**

Plastic & Glass Fiber Pipe

A PIPE, TOUGH enough to withstand heavy pressures yet light enough to be carried by a child, impervious to corrosion but flexible enough to be bent by hand, is announced. It will have many applications, including salt water lines, crude oil lines, oil well tubing, gas distribution lines, water distribution systems, oil products lines, irrigation pipe, electrical conduit and in mines and chemical plants. It need not be coated, wrapped or given cathodic protection to keep from rusting. It can be placed by hand or with light machines and joints bent to conform with ditch coutours. Once bent they will return to form when released. A glass smooth interior insures a high flow factor which means greater delivery capacity. Moisture absorption is negligible. It is not affected by temperatures ranging from minus 65 deg to plus 300 deg Fahrenheit. Tests show greater strength at lower temperatures. Weight is 1/8 that of steel pipe. It has high impact strength and will not conduct electricity. Two sizes are now being manufactured, 3-1/2 and 4-1/2 in., while 6-5/8 and 2-3/8 in. are in the process of development. **Perrault Brothers Plastic Pipe Div., Tulsa, Okla.**



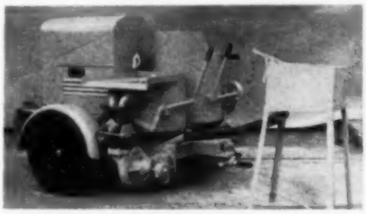
Equipment, Materials & Methods (Continued)

Pump

THE SUBMERSIBLE Drain-Pak, a small $^1/_3$ hp sump and all-purpose pump has been developed. One of its foremost engineering advantages is floatless construction. With no float, no diaphragm, and no electrodes to fail or require adjustment, the Drain-Pak is a "fool-proof" unit. Simplicity is further increased and maintenance reduced because no lubrication is required at any time and there is no oil to leak out. Weighing only 31 lbs, it is easily carried by one man. It can be lowered to depths up to 15 ft. The maximum capacity is 3300 gph. Tests prove that the Drain-Pak provides outstanding performance for emptying sumps and also when used as a general utility unit to pump out flooded cellers, ditches, pits, elevator shafts, construction excavations and all hard-to-get-at places. **The Lancaster Pump and Manufacturing Company, Inc., Lancaster, Pa.**

The Colcrete Process

THE COLCRETE PROCESS consists of making a grout of cement, sand and water in which the cement has been so completely hydrated by high speed mechanical mixing that the grout attains a colloidal form. This grout is termed Colgrout and is stable and particularly fluent. It contains no chemical admixtures which might ultimately be harmful. When Colgrout is poured on to aggregate over $1^1/_2$ in. in size the voids in the aggregate are completely filled by penetration and the whole sets as a dense, solid concrete which



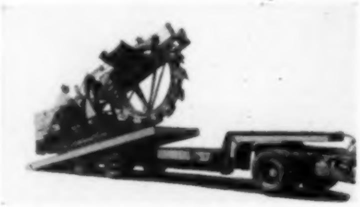
Mark III Mixer

is termed, Colcrete. Thus, in making concrete by the Colcrete Process the aggregate is dumped or placed direct in position without having to be handled through a mixer. The cement, sand and water are in the form of a fluent grout from which the solids will not separate and this grout is pumped by the Colcrete mixer on to the pre-laid aggregate. The Colcrete Process can be used for any type of concrete work in which aggregate of $1^1/_2$ in. in size or over can be used. It is ideally suited to conditions where large aggregate up to cyclopean size is available and it is immaterial whether the aggregate is dry or inundated. A booklet on the history, advantages and applications of the Colcrete colloidal concrete is available. **Carroll E. Bradberry, Colcrete U.S.A., P.O. Box 1153, Los Altos, Calif.**

Equipment, Materials & Methods (Continued)

Heavy-Duty Trailer

A HEAVY-DUTY GOOSENECK-type trailer with tilting platform, for transporting heavy machinery with standard fifth wheel tractors, has just been announced. The trailer is easily loaded or unloaded in 5 min by one man, without skids or blocking. Available in 14, 18 and 22 ton capacity, the Model GTTA trailer is of tandem



Easily Unloaded with Tilting Platform

axle design, with 96 in. width platform, which tilts into loading position by releasing a simple lock at front of platform. Two double-acting hydraulic cylinders "cushion" load during tilting. After load is driven or winched into place, platform locks automatically in horizontal position for hauling. The trailer is ruggedly constructed with one-piece formed gooseneck and subframe, and is equipped with "walking beams" supporting the axles, to provide maximum oscillation for equal load distribution over any type road surface. Constant rise S cam brakes operated by worm gear slack adjusters assure perfect braking contact at all times. Three lash hooks on each side are included as standard equipment, with the usual lights, reflectors, stake pockets and other accessories available at extra cost. **La Crosse Trailer Corp., La Crosse, Wis.**

Concrete Construction Material

THE BUILDING OFFICIALS Conference of America has announced its code approval of Cofar, a reinforced concrete construction material. Cofar is a prefabricated combined form and reinforcing unit fabricated from cold-rolled tough-temper steel. It provides a one-stage operation system for placing positive reinforcement and for forming concrete on either steel or concrete frame construction. In residential construction, reinforced concrete floors and roofs were almost prohibitive because of cost but Cofar is now being supplied to home builders. The material is non-combustible, termite proof and has great strength advantages but costs are comparable with those for wood floors. The Cofar system also provides clean, finished ceilings for the basements of homes without further finish treatment. Write on firm's letterhead and request Report No. 51-10. **Granco Steel Products Co., Dept. 512-9, P. O. Box 221, Granite City, Ill.**

Literature Available

PLUNGER PUMP—An 8-page, two-color bulletin, No. 5182, describes the Dorrco plunger pump in detail with photographs, drawings, capacity tables and text. Also included are a complete set of sample specifications and preferred arrangement drawings for the pump when located at different elevations with respect to the clarifier. **The Dorr Company, Barry Place, Stamford, Conn.**

ALMANAC—An almanac supplement, listing 28 selected stars for determination of azimuth by stellar observation, is an innovation of the 1952 edition of the Gurley Ephemeris. The main section of the Ephemeris includes definitions of astronomical terms, descriptions of methods of observation and examples of reducing data for determining a true meridian. Also included are tables abridged from the American Ephemeris and Nautical Almanac and the Standard Field Tables, Bureau of Land Management. **W. & L. E. Gurley, Troy, N.Y.**

HEAVY-DUTY FORMS—A description of the heavy-duty self-aligning paving form, which was developed especially for airport paving, is included in a 12-page bulletin. The bulletin contains detailed construction features, including the quick-operating lock-joint slide plates for connecting the forms. Complete specifications on forms from 8 in. by 8 in. to 12 in. by 12 in. are given, with additional engineering specifications and suggested purchasing specifications. Ask for Bulletin 2370. **Blaw-Knox Division of Blaw-Knox Company, Farmers Bank Bldg. Plittsburgh 22, Pa.**

CONCRETE FACT BOOK—An enlarged edition of the Protex Modern Placement of Concrete fact book, has been recently published. The edition contains the latest technical information and field use tips on air-entrained concrete. Complete with photographs of the latest concrete construction projects, the book is full of question and answer information about air-entrainment technique and Protex air-entraining solutions. Many photographs have been included to show actual test pictures of concrete with and without Protex air-entrainment solutions. **Autolene Lubricants Company, Industrial & Research Div., Denver 9, Colo.**

COMPANY'S PRODUCTS—A general catalog is now available to acquaint industry with the complete American line of equipment. It covers all equipment from the giant revolver cranes, through the extensive line of locomotive cranes, hoists, material elevators, car pullers right down to the Crosby wire rope clips. There are plenty of actual "on the job" pictures with minimum reading. Also included with each catalog is a return card which enables the recipient to send for catalogs of the equipment he is especially interested in. Ask for Catalog GC-2 **American Hoist & Derrick Company, 63 S. Robert St., St. Paul 1, Minn.**

Literature Available (Continued)

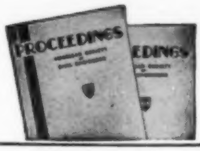
Technical Bulletin Sheet—Prufcoat Technical Bulletin No. 501 shows in chart form the chemical resistances of various types of Prufcoat. Based on both laboratory tests and practical field applications, the Technical Bulletin provides potential users with the resistance ratings of Standard Series Prufcoat, "A" Series Prufcoat and Prufcoat BX white enamel to some 69 corrosive chemicals (in both concentrated and dilute form). Write to **G. Russell Hersam, General Sales Manager, Prufcoat Laboratories, Inc., 50 East 42nd St., New York 17, N. Y.**

Steel Bridge Flooring—A comprehensive folder on IQ-35 steel bridge flooring is just off the press. This latest development whether laid longitudinally or transversely on a bridge, will carry H20 loading (highway load of 20 tons) on a 15 in. circle up to a span of 48 in. and weighs approximately 19 lbs. Write to **Kerlow Steel Bridge Flooring Co., 222 Culver Ave., Jersey City 5, N. J.**

3-Wheel Roller—A bulletin describing general purpose 3-wheel rollers is being announced. Illustrations and information pertain to the 8, 10, 12, and 14 ton 3-wheel rollers, gasoline and diesel, in the Huber line of road maintenance equipment. The bulletin is two-color throughout and has 20 pages. It gives a comprehensive explanation of the various parts assembled in a roller, and describes the general purpose duties of the units. **Huber Manufacturing Company, Marion, Ohio**

Milli-Second Delay Blasting—A 20-page manual describing and illustrating eight methods of blasting in quarries with milli-second delays has been issued. The manual contains previously unpublished machine-gun photographs and methods of shooting to illustrate both progressive and alternate milli-second delay techniques. Included are discussions on the principles of milli-second delay blasting, diagrams of eight milli-second delay detonation patterns, series of photographs showing alternate and progressive blasts and sketches explaining why the Rockmaster 16 blasting system gives better breakage, reduced vibration, reduced air blast, better toe action and minimized backbreak. **Atlas Powder Company, Wilmington, Del.**

Soil Compaction—"Cost Data for Soil Compaction in Restricted Areas" is the title of an interesting, new technical bulletin which has been prepared for contractors and construction engineers. The cost figures are based on a survey of actual jobs and are intended to be helpful to contractors in preparing bids and maintaining cost records. In addition to covering direct cost items such as depreciation, interest, insurance, taxes, fuel and repairs, the bulletin discusses overhead charges and possible variations in conditions on various jobs. **Barco Manufacturing Co., 1801 Winnemac Ave., Chicago 40, Ill.**



PROCEEDINGS AVAILABLE

The following papers, printed as Proceedings Separates, may be ordered on the basis of summaries given in this and previous issues of CIVIL ENGINEERING. Discussions of these papers will be received, as in the past, for a period of five months following the date of issue. A summary of each paper appears in several consecutive issues; other titles will be added every month, as they become available. Use the convenient order form on page 114.

Summarized in Earlier Issues

113. **Wave Forces on Breakwaters,** by Robert Y. Hudson.

114. **Utilization of Underground Storage Reservoirs,** by Harvey O. Banks.

D-51. Discussion of Paper, **Laterally Loaded Plane Structures and Structures Curved in Space,** by Frank Baron and James P. Michalos.

D-57. Discussion of Paper, **Design of Irrigation Systems,** by W. H. Nalder.

D-60. Discussion of Paper, **Surveying and Mapping Requirements for Modern City Planning,** by Charles A. Blessing.

D-62. Discussion of Paper, **The New Towns Program in Great Britain,** by T. C. Coote.

115. **Lake Michigan Erosion Studies,** by John R. Hardin and William H. Booth, Jr.

116. **Graphical Solution of Hydraulic Problems,** by Kenneth E. Sorensen.

117. **Development of Stresses in Shasta Dam,** by Jerome M. Raphael.

118. **Flocculation Phenomena in Turbid Water Clarification,** by Harvey F. Ludwig, W. F. Langelier, and Russel G. Ludwig.

D-56. Discussion of paper, **Turbulent Transfer Mechanism and Suspended Sediment in Closed Channels,** by Hassan M. Ismail.

D-70. Discussion of **Regime Theory for Self-Formed Sediment-Bearing Channels,** by T. Blench.

119. **Thin-Walled Members in Combined Torsion and Flexures,** by Warner Lansing.

120. **Surface Water Wave Theories,** by Martin A. Mason.

121. **Rate of Change of Grade per Station,** by Clarence J. Brownell.

122. **Engineering Aspects of Diffraction and Refraction,** by J. W. Johnson.

D-59. Discussion of Paper, **Limit Design of Beams and Frames,** by H. J. Greenberg and W. Prager.

D-65. Discussion of paper, **National Topographic Mapping,** by W. E. Wrather.

D-71. Discussion of Paper, **Rectification of the Papaloapan River in Mexico,** by Reynaldo Schega.

Third Notice

123. **Long-Period Waves or Surges in Harbors,** by John H. Carr.

124. **Influence Lines by Corrections to an Assumed Shape,** by James P. Michalos and Edward N. Wilson.

125. **Torsion of Plate Girders,** by F. K. Chang and Bruce G. Johnston.

126. **Variation of Wind Velocity and Gusts with Height,** by R. H. Sherlock.

D-53. Discussion of Paper, **Wedge-Beam Framing,** by Arsham Amirikian.

D-72. Discussion of Paper, **Design of Large Coal Bunkers,** by Paul Rogers.

Second Notice

127. **Stresses in Deep Beams,** by Li Chow, Harry D. Conway, and George Winter. Beams whose depths are comparable to their spans are used in a variety of structures. Information for single-span beams is presented in this paper. Five cases of loading are studied and for four of these cases, three different span-to-depth ratios are examined. Distribution and magnitude of binding and shear stresses are given in graphical and tabular form suitable for direct use in design. Although this information is applicable to structures made of homogeneous material, their use in connection with reinforced concrete requires some special considerations that are briefly outlined. (Available June 1.)

128. **Horizontally Curved Box Beams,** by Charles E. Cutts. A beam curved horizontally through an angle of 90° and resting on four supports is analyzed for maximum torque, shear, moment deflection, and rotation when the beam carries a uniform load. Three types of curved box beams were fabricated and tested with five concentrated loads placed symmetrically on the curved part of the beam to assimilate uniform loading. Unit strains were measured at critical points on the beam by means of SR-4

INSTRUCTIONS

1. Papers are to be ordered by serial number. Please keep record of Separates you have ordered to avoid unwanted duplication.

2. Any ASCE member may order a total of 40 copies of papers during the fiscal year ending September 30, 1952, without charge. These may be duplicates of the same paper, separate papers, or a combination of both.

3. Members' accounts will be charged at 25¢ each for orders exceeding 40 copies in a fiscal year. Charges for excess copies or for subscriptions will be included on the 1953 dues bills.

4. Non-members of the Society may order copies of PROCEEDINGS papers by letter with remittance of 50¢ per copy; members of Student Chapters 25¢ per copy.

5. Discussions of each paper, with author's closure, also will be published as a Separate and must be ordered in the same manner as other Separates, except that no charge will be made for the discussions of a paper previously ordered. The order form will list available discussions of papers. Discussions will be numbered to agree with the basic paper.

Standing orders for all Separate papers, including their Discussions, in any calendar year, may be entered at the following annual rates: Members of ASCE, $3.00 (beginning January 1, 1952, $5.00); members of Student Chapters, $5.00; non-members, $10.00, plus foreign postage charge of $.75; libraries, $5.00.

TRANSACTIONS. All PROCEEDINGS papers, with discussions, will be included in TRANSACTIONS. Annual volumes of TRANSACTIONS will continue to be available at the currently established annual subscription rates.

	To Members	To Non-Members
Leather binding	$4.00	$18.00
Cloth binding	3.00	17.00
Paper binding	2.00	16.00

electrical strain gages. A new method of design for closed section curved beams and a theoretical development for determining rotation and longitudinal warping stresses are included. (Available June 1.)

129. **Analysis of Arch Dams of Variable Thickness,** by W. A. Perkins. It is always desirable to build an arch thicker at the abutments than at the crown in order to secure the most economical design. Heretofore, however, the determination of stresses in such a structure has been extremely laborious, but with the aid of the formulas and curves presented in this paper, the stresses can be determined by slide rule in a very short time. Furthermore, practical use of the formulas and curves does not require a thorough comprehension of the mathematics involved in the development. (Available June 1.)

130. **Underground Corrosion of Piping,** by R. A. Brannon. This discussion of the subject of underground corrosion of piping is based on the writer's experience in the industry of transporting liquid petroleum by pipelines, and his association with others in this industry and the related industry of transporting petroleum gas by pipelines. Although the underground piping systems with which members of the ASCE are concerned may differ in many respects from those in the oil and gas industries, it is likely that many of the corrosion problems are common to all of them. This paper is limited to the outside metal piping buried in soil. (Available June 1).

131. **The Allegheny Conference—Planning in Action,** by Park H. Martin. Since 1943 the Allegheny Conference on Community Development has been developing and backing a plan of municipal improvement for the greater Pittsburgh, Pa., area. Among the many civic improvements credited to the Conference are a successful smoke-abatement program, highway and bridge development, planning for stream-pollution abatement, and alleviation of parking congestion in the city. (Available June 1.)

132. **Specifications for Structures of a Moderate Strength Aluminum Alloy of High Resistance to Corrosion, Progress Report of the Committee of the Structural Division on Design in Lightweight Structural Alloys.** The specifications cover allowable stresses, design rules, and fabricating procedures for structures built of aluminum alloy known commercially as 61S-T6. (Available June 1.)

D-66. Discussion of Paper, **Lateral Forces of Earthquakes and Wind,** by a Joint Committee of the San Francisco Section of ASCE, and the Structural Engineers Association of Northern California. The original paper, published in April 1950, developed a dynamic criterion for design of lateral earthquake and wind forces and a provision for building codes based on this criterion. Discussers are: Seismic Research Group; Reuben W. Binder; R. R. Martel; G. W. Housner and J. L. Alford; S. K. Guha and Gurdas Ram; and a Joint Committee of the San Francisco Section of ASCE, and the Structural Engineers Association of Northern California. (Available June 1.)

D-79. Discussion of Paper, **Stage Predictions for Flood Control Operations,** by Ralph E. King. The original paper, published in July 1951, described the problems relative to the prediction of stages in the lower Mississippi River Valley during flood periods. Discussers are: Robert Buehler and W. S. Hoehl, and Ralph E. King. (Available June 1.)

D-80. Discussion of Paper, **Mississippi River Valley Geology Relation to River Regime,** by Harold N. Fisk. The original paper, published in July 1951, described the geology of the alluvial valley of the lower Mississippi River and major changes in stream activity. Discussers are: Leo M. Odom, Stafford C. Happ, and Harold N. Fisk. (Available June 1.)

First Notice

133. **Uplift in Masonry Dams: Final Report of the Committee on Masonry Dams of the Power Division, 1951.** Essentially a digest of information and practice, this report is presented as a statement on foundation uplift. Information aiding the designer to arrive at adequate assumptions as to uplift effects in dams is important. Prospects of alleviating the scarcity of this information in the near future are not very promising. However, available data are held to be adequate to warrant a report on this phase. (Available July 1.)

134. **Solution of an Hydraulic Problem by Analog Computer,** by R. E. Glover, D. J. Herbert, and C. R. Daum. This paper discusses the general conditions of the problem of flow distribution in a network of estuarine channels to which an analog computer model was applied. After developing the analog requirements, the model is described with emphasis on the electronic circuit that provides the required square-law resistance. The equations correlating electrical and hydraulic quantities are developed from the basic electrical and hydraulic relationships. Finally, the methods by which the required boundary conditions were duplicated are discussed. (Available July 1.)

135. **Application of Electronic Flow Routing Analog,** by Max A. Kohler. The Weather Bureau's electronic streamflow analog is shown to be an effective device for the preparation of river forecasts where the Muskingum storage equation is applicable. It is equally adaptable to the routing of flow from point to point along the stream or to the direct routing of effective rainfall (runoff). The basis for the circuit employed in the analog and the methods of operating the equipment is discussed briefly. The basis for a circuit design that would make analog routing applicable to virtually all cases is also discussed. (Available July 1.)

136. **Steady-State Forced Vibration of Continuous Frames,** by C. T. G. Looney. A method of analysis is described for the steady-state forced vibration of continuous frames. All members are considered as simply supported and the end slopes found by means of harmonic analysis. The geometrical discontinuity with adjacent members is corrected by periodic end moments by means of a distribution procedure. Adapted to this analysis, the distribution procedure is an analytical tool familiar to most structural engineers. (Available July 1.)

D-75. Discussion of Paper, **Base Course Drainage for Airport Pavements,** by A. Casagrande and W. L. Shannon. The original paper, published in June, 1951, described observations on a number of airfields, illustrating the principal causes for the saturation of base courses of airfield pavements. Discussers are: Edward S. Barber, D. P. Kyrnine, and A. Casagrande and W. L. Shannon. (Available July 1.)

D-76. Discussion of Paper, **Model Tests Using Low-Velocity Air,** by James W. Ball. The original paper published in June, 1951, presented the use of low-velocity air testing to solve flow problems pertaining to hydraulic conduit systems. Discussers are: David W. Appel and James W. Ball. (Available July 1.)

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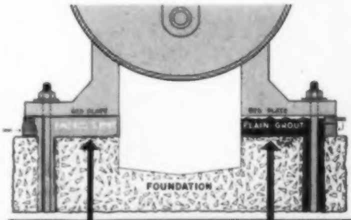

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